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THE WORLD IS ITS FIELD

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RECENT PROGRESS AT PANAMA.

By Fullerton L. Waldo, F. R. G. S.

Mr. Waldo's report of personal observations lately made on the Isthmus is welcomed because it expresses the verdict of a normal, healthy, well-informed and open mind free from commitment to any special or pre-conceived opinions. It is of further interest because it affords comparison with a preceding examination made under closely similar circumstances three years ago. For the accompanying views we are indebted to the courtesy of the Isthmian Canal Commission, through Capt. F. C. Boggs, Corps of Engineers, U. S. Army, Chief of Office.—THE EDITORS.

THE rapid progress that has been made in the last few months at Panama can scarcely be comprehended from the perusal of the statistics and the sober digest appearing from week to week in the Canal Record. I was on the Isthmus in January, 1907, and my impressions of the work as it then was appeared in the following month's issue of THE ENGINEERING MAGAZINE. Having just returned from the Isthmus, where I spent the last week in July, I am moved to institute a comparison—which should not prove odious—with conditions in 1907.

At the time of my previous visit the army administration was about to take hold of the work. Wallace and Stevens rendered splendid service and will be honorably remembered. The work they did made possible the work that is going on now. Long after acrimonious discussion is forgotten, the positive achievement of a man counts in his favor; and so it will prove in the case of the two great civilian chief engineers.

The men of the army, in the soldierly spirit of mute obedience, have continued to "make good." Colonel Goethals daily builds his imperishable monument; Colonel Gorgas, by showing white men how

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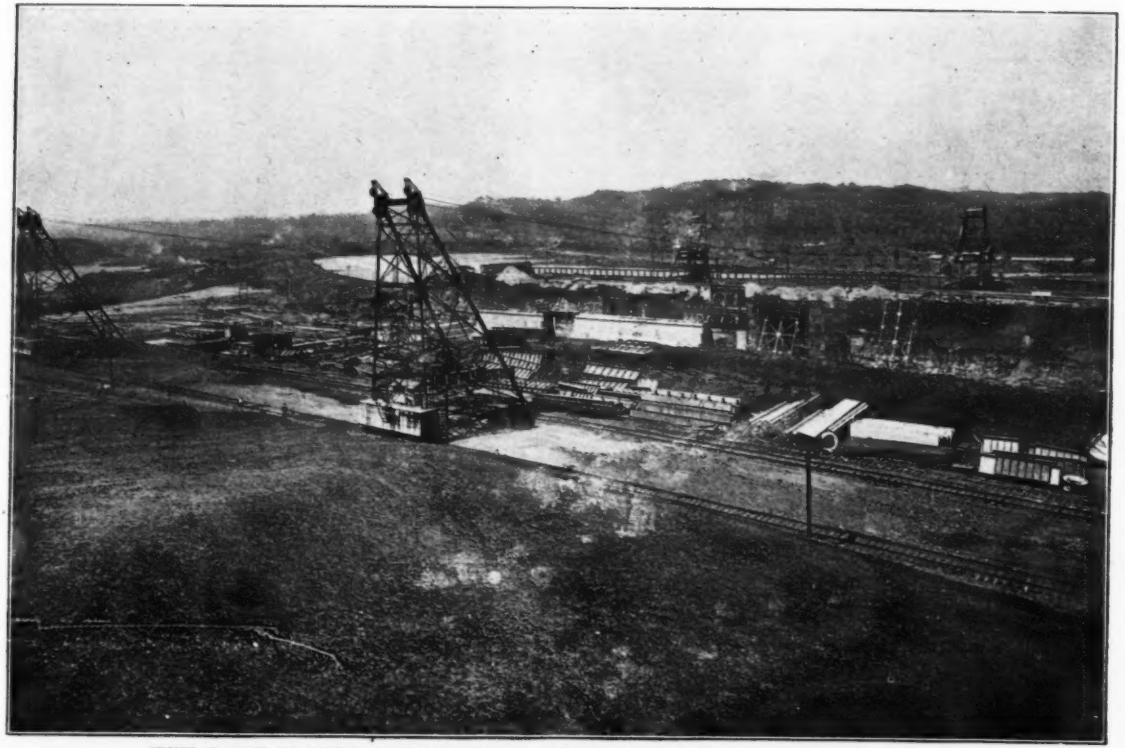
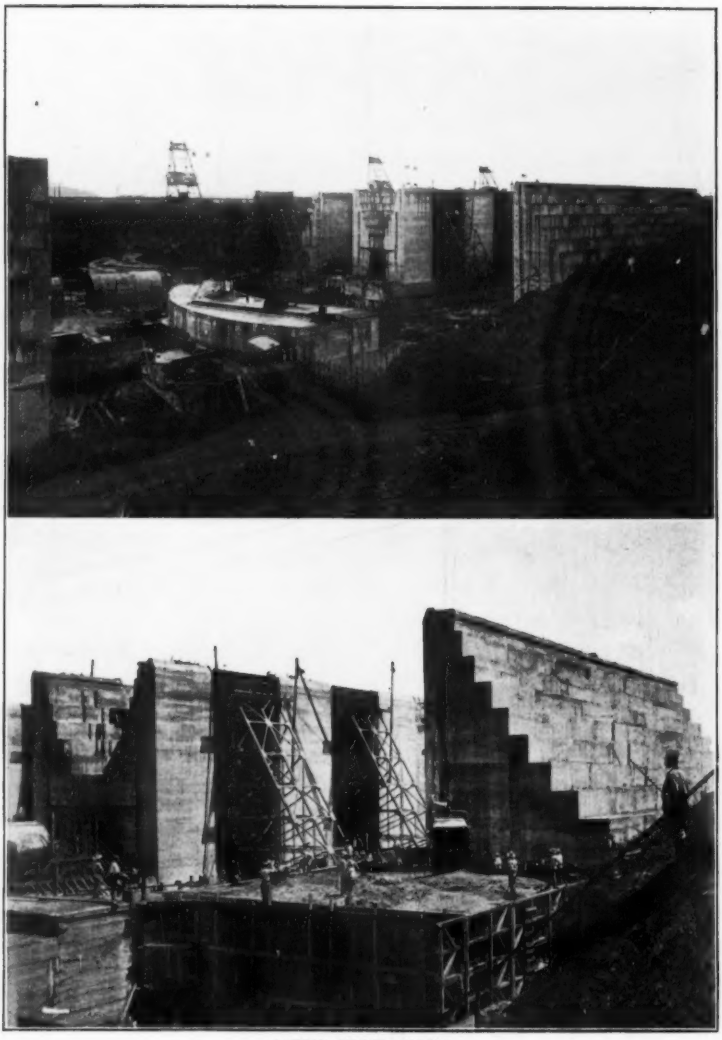


GENERAL VIEW OF GATUN LOCK CABLEWAYS, SHOWING THE DAM SITE IN THE BACKGROUND.

they can live in the tropics, has placed humanity for all time deeply in his debt. It is not too much to say there would have been no near probability—much less the confident assurance—of a canal if Gorgas had not expurgated yellow fever along with the *stegomyia,* and minimized the malarial burden of *anopheles.* But panegyric is apart from the purpose of the present article, the aim of which is merely to contrast what there was "to show for the money" three years ago, and what exists today as a refutation of the scepticism of those who opposed the Isthmian waterway—a carping band of obstructionists and pull-backs now mostly shamed into silence.

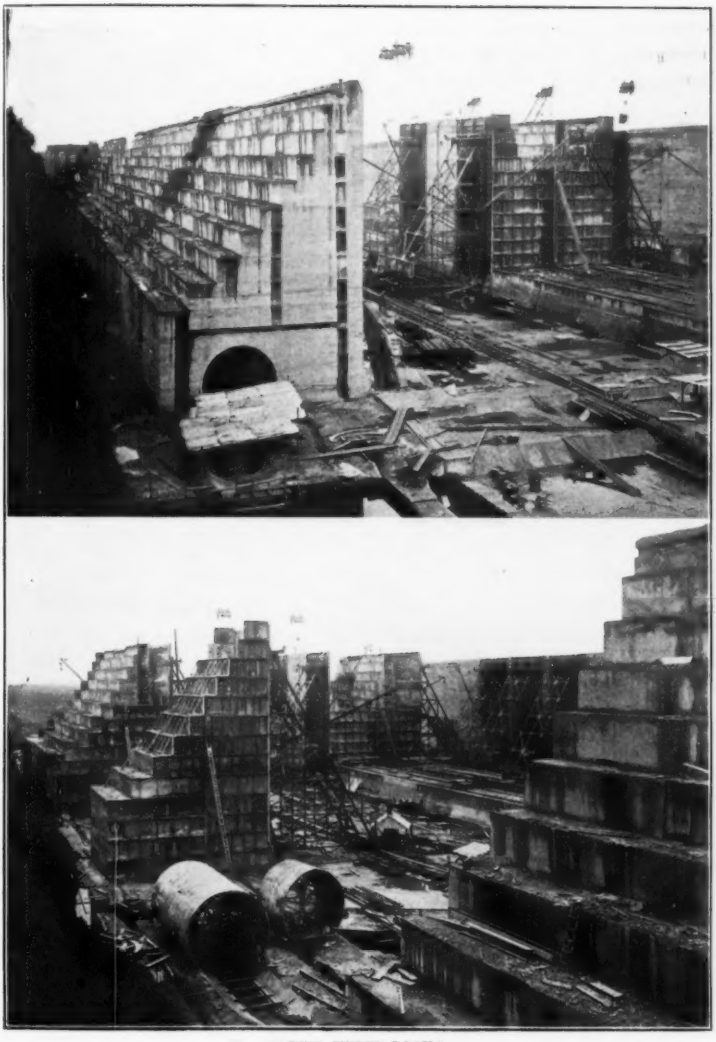
In January, 1907, there was one lonely little steam shovel courageously butting into the hillside at Gatun, making a beginning of the excavation for the locks. Down below, a steam launch drowsed on the stagnant strip of water that represented what was left of the shallow channel dug for seven miles from the sea at Colon by the French. There was a palm-thatched native village, and a wooden gray Catholic church thrust its spire a little above the tallest fronds of the cocoanut-palms. The chocolate-brown Chagres swirled insolently down the middle of the wide green valley and otherwise there was scarcely a break in the ample expanse of greenery from hill to hill. They showed us blueprints of 580 borings taken to prove that a vast earth-barrow half a mile thick and a mile and a half long, could without percolation blot out the village, bar the river and form a lake reaching for 24 miles to the backbone of the continental divide at Culebra. We believed what they told us; but there were a great many untechnical, average people here at home who asked doubtfully of everyone who came from the Isthmus in those days, "Do you really believe they are going to be able to put the canal through?" For the obsession of the French failure still weighed heavily on the minds of many doubting Thomases, and the optimistic prophecies of the toilers on the spot seemed too good to be true.

We ran all over the premises at Gatun, in the division engineer's track-automobile; we climbed into and around the huge lock-chambers, breathed the choking dust of the concrete-mixers, and risked the third-rail system animated by the magnificent new power-house. It was hard to believe it was the same place as the site of the furtive operations of the single shovel in 1907. The indignant Chagres, uncurbed since the first Spanish occupation, now rioted seaward through a 300-foot spillway channeled through a mound in the middle of the dam-site. Already the Gatun Lake has become a very considerable sheet of water, dotted here and there with a surviving clump of trees



GATUN UPPER LOCKS.

Above, the lift sill and forebay from the east bank. Below, constructing monoliths of concrete. Views taken about the first of June, 1910.

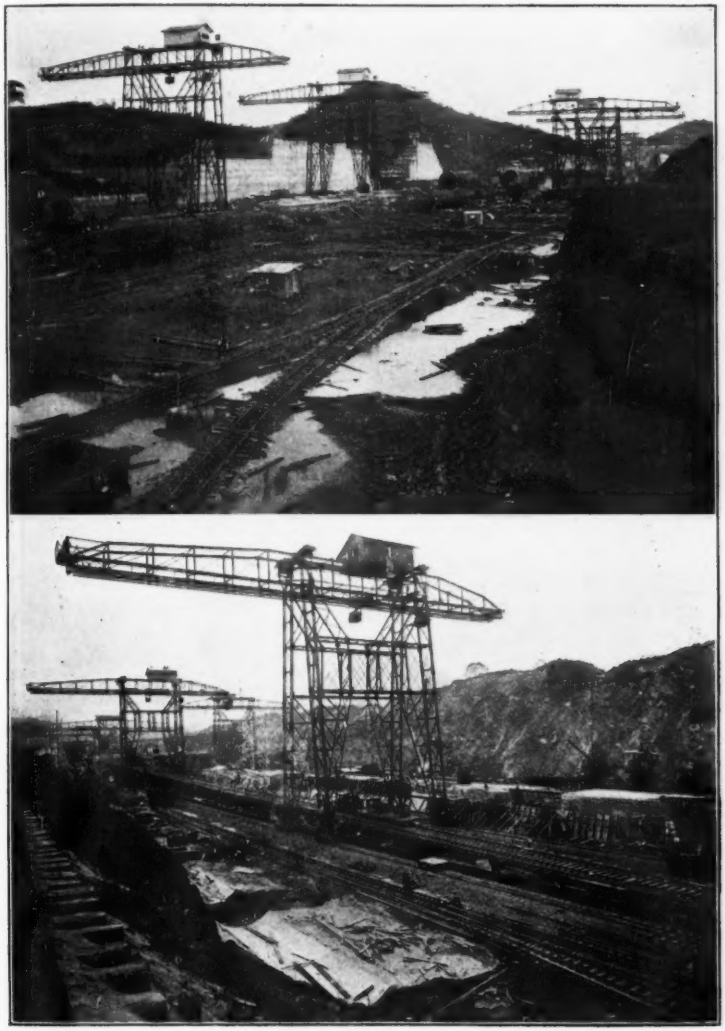


GATUN UPPER LOCKS.
Above, looking south from the east bank, July 2, 1910. Below, looking north from the west bank at the same date.

or an abandoned roof, and requiring the constant presence of one of the big dredges with living-quarters as comfortable as those of a houseboat. The great, terraced lock-walls instantly challenged comparison with the work of the builders of the mausoleum of Cheops. You could hardly understand how much concrete goes into these "monoliths" as they are called, till you saw the barrels and bags stored in the sheds. On July 26 the Ancon arriving at Cristobal unloaded 33,000 barrels and 80,000 bags of cement, and was away again in 24 hours, and nobody made the slightest fuss about it. In one day last June, Colonel Sibert told me, they put down 3,998 cubic yards of cement on the lock site, and in the working days of the month were laid a total of no less than 89,000 cubic yards. The masonry work for the first pair of locks will assuredly be completed by November. The floor of the second pair of locks is already prepared to receive the superstructure. The shovels are now grubbing 40 feet below sea-level to complete the necessary excavation for the third pair of locks—and this, it is expected, will be done by January.

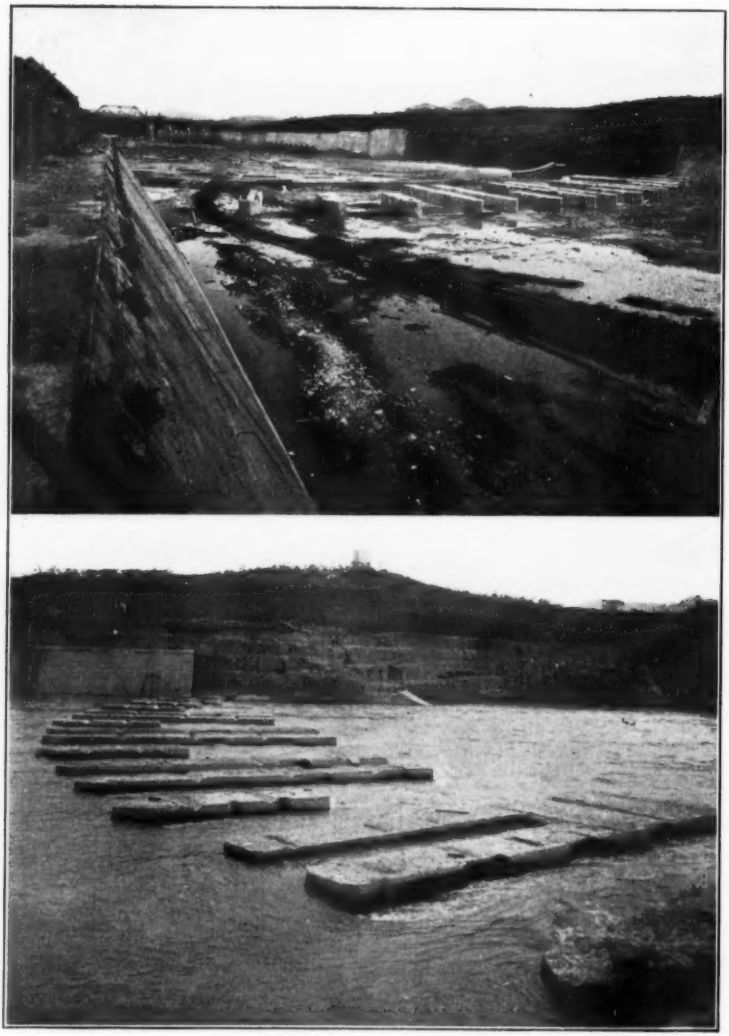
We were shown in the central offices at Culebra a most interesting model of a typical completed lock with a small wooden replica of the Olympic going through it. The Olympic is one of the new Titans of the White Star Line, 850 feet in length and 92 feet wide; and she will have plenty of leeway in a chamber whose usable dimensions are 1,000 by 110 feet. The Olympic, with her 60,000 gross and 45,000 net tonnage represents the largest type of vessel that can seek to cross the Isthmus for a long time to come, and there is still a margin left for ships even more monstrous. The lock-model clearly illustrates the action of safety-gates in checking the flow of water; and a chain from wall to wall in front of the lock chamber, in an emergency, will suddenly restrain a vessel of 10,000 tons moving at 6 miles an hour. The further precaution will be taken to forbid vessels from proceeding under their own steam; they are to be taken in tow by electric locomotives.

It is scarcely necessary to recapitulate the dimensions of the great lock-works and the huge dam that is steadily rising at Gatun. Briefly, the three lock flights divide the vertical distance to the 85-foot level between them, whereas the locks of the Pacific division—the pair at Pedro Miguel and the two combined pairs at Miraflores—have lifts of 33 1-3 feet and 54 2-3 feet, respectively. The dam itself is to be a mile and a half long, 100 feet wide at the top, and 400 feet in thickness at the water line. The crest will be 115 feet above the sea-level—hence 30 feet higher than the general surface of Lake Gatun.



PEDRO MIGUEL LOCKS.

Above, a view northward from the east bank, June 13, 1910. Below, a view looking north from the west bank, taken two months earlier.



THE GATUN SPILLWAY.

Above, a view looking north from the west wall. Foundations for valve and cofferdam piers in the foreground. Below, the southern end of the spillway looking west from the east wall.

The spillway is 1,200 feet in length and there will be an ingenious regulating system installed to maintain the lake, with its area of about 164 square miles, at the desired level.

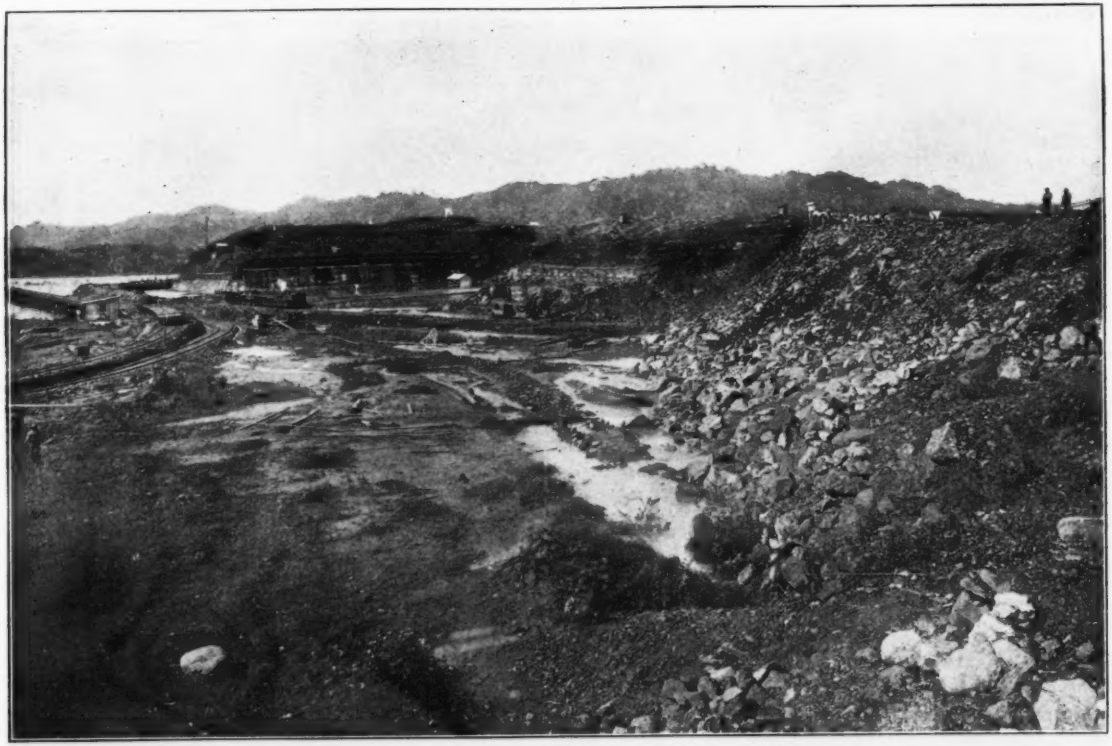
An illustration of the rate at which the hydraulic dredges are now working at Gatun is an episode that occurred a few hours before our visit. One of the sturdy Gallegos Spaniards, who bear the brunt of the more exacting labor, was sucked into the voracious opening of a 16-inch pipe line. Two fellow workmen grabbed him, but he was torn from their hands. In 60 seconds he was carried 265 feet and poured out, gurgling and gasping, on the river's bank. Within a few hours he was back at work again, none the worse for his jarring experience.

It is calculated that the boats ascending the lock-stair at Gatun will not require more than 1½ hours for the transit; and the Pacific locks will detain the vessels for about the same length of time. The average vessel will take from 10 to 12 hours to cross the Isthmus, and there is no reason why passengers should not proceed by train, if they like, in advance of the ships, and disport themselves as they please at either terminus. The train takes 2½ hours for the passage.

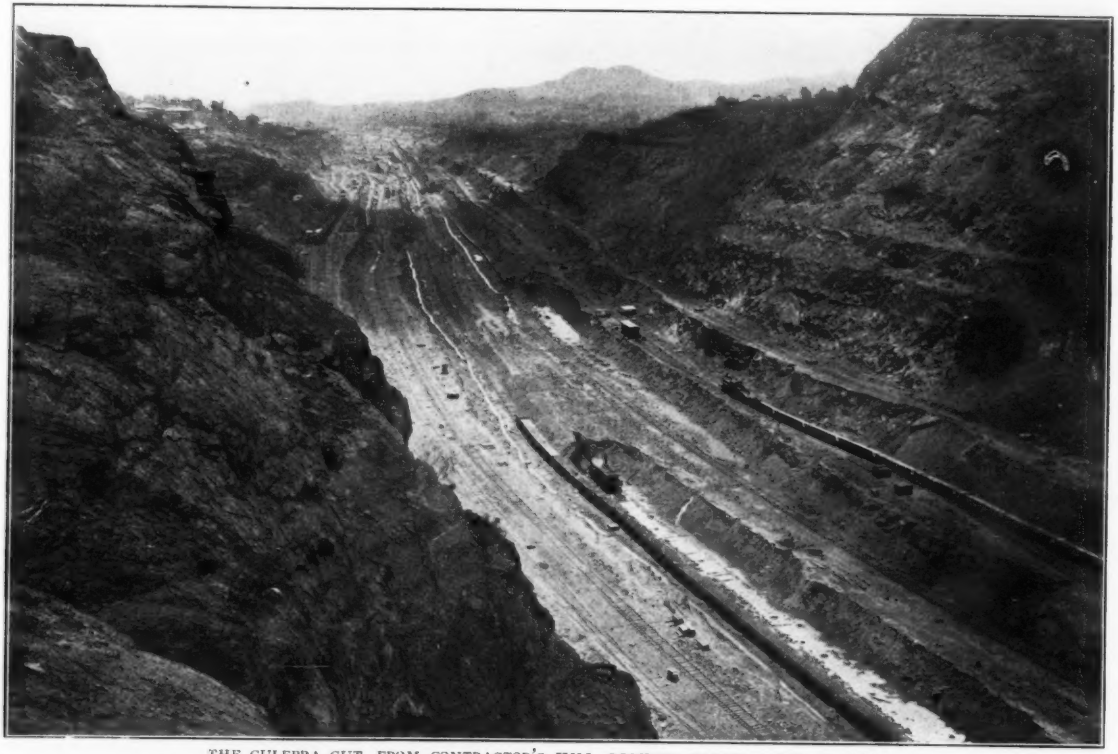
Under ordinary circumstances it will require about 15 minutes to fill the lock-chamber; if there is particular need for haste, the process can be completed in half the time. The available water-supply will allow of 48 lockages per diem—which might easily mean an average of something like 80,000,000 tons of traffic annually, as compared with 21,000,000 tons in the case of the Suez canal and the 40,000,000 tons of the Sault Ste. Marie. The lock-chambers are filled and emptied by means of an interesting system of lateral culverts, which open in the floors and connect with larger culverts in the central and side walls of the lock chamber.

It has, of course, been found necessary to relocate the railroad to bring it around the artificial lake. That is why they have not entirely completed the double-tracking of the present line. From Gatun, the relocated railway will swing some 4½ miles to the eastward of the present right of way, will then traverse the valley of the Chagres, crossing the river by means of a steel bridge ¼ of a mile in length, and will finally come back to the canal at the point where the lake narrows into the excavation in the rock at Bas Obispo, the beginning of the Culebra Cut. The railway at its highest will be 25 feet above the surface of the water. Through the Culebra Cut it will run along on the berm only 10 feet above the canal. From the Pacific side of

GATUN MIDDLE LOCKS, SHOWING STATUS OF CONCRETE WORK JULY 2, 1910.



GATUN SPILLWAY, FROM THE SOUTH TOE OF THE DAM.



THE CULEBRA CUT, FROM CONTRACTOR'S HILL, LOOKING NORTH, APRIL 20, 1910.

the cut (at Paraiso) it will parallel the canal to the shore—branching, of course, to the depot at Panama. Near Miraflores there is to be a tunnel 736 feet long. The complete line will be 46.2 miles in length—shorter by a mile than the present route.

Besides the Gatun Dam with the locks, the other great factor upon which the completion of the canal by 1915 depends, is of course the Culebra Cut. A great deal of nonsense has appeared in print in the United States about the Cucaracha and other slides. Reference to the 1909 Report of the Canal Commission will show that the engineers anticipated slides to the extent of about 4,000,000 cubic yards in the Central Division. They have now generously enlarged their estimate to 7,000,000. Suppose the completion of the canal should be delayed two months by these untoward happenings—what is two months, when mankind has waited for four centuries? Standing on the wooden suspension-bridge thrown across the Cut at Empire, one finds it hard to believe that the excavation of such staggering dimensions is the work of man aided by his own "mechanical extension of his powers." It seems as though it must be the work of convulsive natural forces. If Nature here and there shows herself stubbornly opposed to the invasion of drill and shovel, the greater the eventual triumph of man over Nature. One of the slides occurred the night before we came to Culebra, and the next day we saw a shovel, with dirt-trains in assiduous attendance, eating out the heart of it. It was a big slide, a slide that worried the heads of the work, and yet no layman could have seen what there was to make such a fuss about. To read some of the saffron-tinted journals, a "constant reader" 2,000 miles from the spot would be almost sure to believe that the walls of the Cut from top to bottom were caving in. On the spot, there seems to be practically nothing the matter. Moreover, if at the usual angle the earth refuses to stand still, there is no reason why the surface should not be given an outer integument of rock; and in due time the intertangled roots of tropic plants and trees luxuriantly growing will themselves form a sufficient natural protection. Meanwhile, a few of the older houses will have to be moved back from the brink—but what of that? Some of them must be shifted anyway, because the Americans have planned more liberal dimensions than those contemplated thirty years ago by the French engineers.

The official statement of the canal excavation to August 1, 1910, including the allowance for the slides at Culebra, shows 113,135,206 cubic yards excavated since May 4, 1904, when the Americans began

work, and 69,402,560 cubic yards remaining to be taken out. Although, to be sure, the excavation of July of the present year amounted to but 2,406,288 cubic yards, this was in the middle of the rainy season, and about twice as much per month can be accomplished in the "dry" months of mid-winter.

The best assurance of the completion of the canal at the time assigned is, after all, not the official report from month to month of the cubic yardage of the shovels, in their intense rivalry judiciously encouraged by the administration. The most convincing exhibit at Panama is the character of the working population itself. There were good men on the Isthmus in 1907, plenty of them, with "their souls in the work of their hands" and the useful knowledge of the schools in their heads, plus the fruition of valuable experience elsewhere. But in 1910 the laborers in all particulars worthy of their hire are excessively in the majority, where formerly they were merely numerous. They have brought their families to the Isthmus, secure in the knowledge of healthful surroundings, good schools, a generally moral environment, social diversions and a thoroughly satisfactory commissariat. The number of gardens, in three years, has increased greatly. The people really seem to care to make their door-yards beautiful. Panama begins to appear like home to them. They are not merely biding their time, in durance vile, until the six-weeks' annual vacation. Every kind of fraternal organization that flourishes in the United States has taken firm root upon the Isthmus. The baseball rivalry is as fast and furious as that of the steam shovels. There is a splendid opera-house in the City of Panama, opened in November, 1908, with a brilliant performance of "Aida." Whereas there were but two automobiles three years ago, the passing of the "benzine buggy" today arouses no comment. The millions of vitrified brick have made Panama by all odds the best-paved city between the capital of Mexico and Buenos Ayres. The railroad that is building westward to David, in the province of Chiriqui near the frontier of Costa Rica, will be an important link in the Pan American Railway that is as sure to come as the Cape-to-Cairo Railway; and when this great international highway is completed it will be possible to go by rail from New York to Panama in something like the time the steamships now require—though the distance overland is 2½ times as great. In the meantime there is no room for any but an optimistic opinion in the mind of every American as to the present and the future of the Panama Canal.

COBALT IN 1910.

By Arthur A. Cole.

Mr. Cole's article is a clean-cut, authoritative and original review of one of the most interesting camps of the day. It gives, in admirably concise form, most useful knowledge of the geological, mining, and economic conditions and of the prospects of the region. The underground photographs, specially taken and copyrighted by the author, are particularly interesting. All rights reserved.—THE EDITORS.

DURING the summer of 1895 the writer had the pleasure of working in the District of Nipissing, Northern Ontario, as assistant to Dr. A. E. Barlow, then one of the field geologists of the Canadian Geological Survey. At that time the district was unmapped excepting Lake Temiskaming and the Montreal River. The rest of the country was practically unknown, except to the Indians and the Hudson's Bay Company. The country was thickly wooded, so that in order to obtain even the barest outline of the geology of the area it was necessary to depend mostly on the natural exposures along the banks of the rivers and the shores of the lakes. Asked as to the mining possibilities of the country, Dr. Barlow stated that, judging from the large areas of diabase that were being encountered, comparable to the nickel-bearing norite masses of Sudbury, he had every expectation that the country would produce valuable mineral deposits, but just what they were likely to be it would be impossible to predict. A little cobalt bloom was found at the time of that survey on Rabbit Lake, near Temagami, but no silver. It was not until eight years later, in the fall of 1903, that La Rose, a blacksmith working on the construction of the Temiskaming & Northern Ontario Railway, made his historic discovery of native silver in the now famous La Rose property in Cobalt.

From the first the officers of the Bureau of Mines, Toronto, realized the importance of the find and the new camp was given constant and most valuable assistance by the Bureau. Geological maps of remarkable accuracy, considering the difficulties under which they were compiled, were early issued and these were of immense benefit to the prospectors. The report of Dr. W. G. Miller, Provincial Geologist,

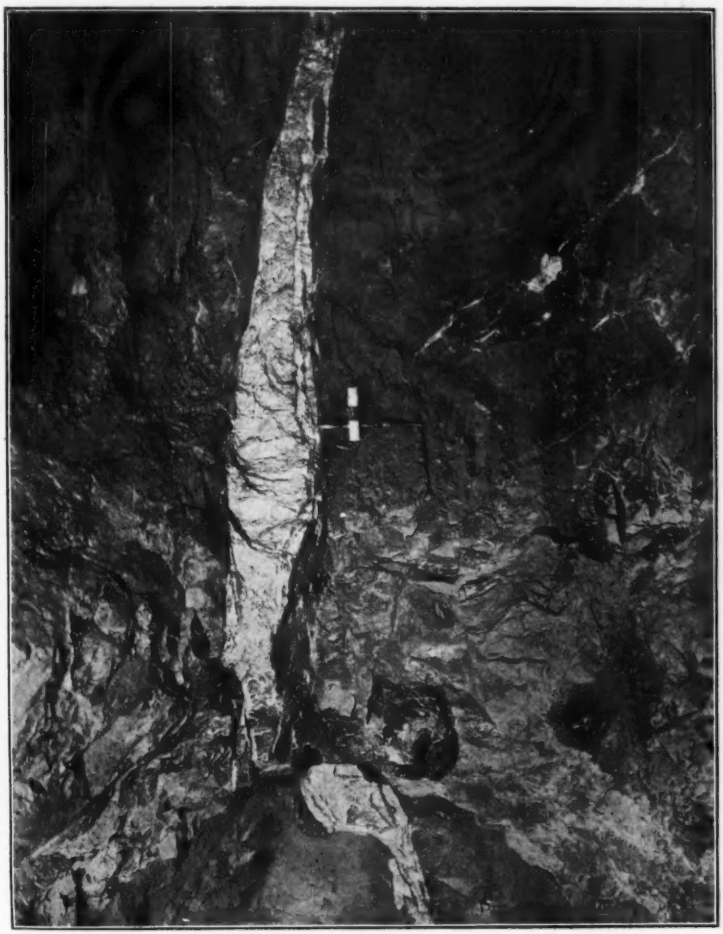
SILVER VEIN IN CROWN RESERVE MINE, NEAR COBALT. MAXIMUM WIDTH 6 INCHES 200 FOOT LEVEL, IN HURONIAN FORMATION.
Copyright, 1910, by A. A. Cole.

and his able assistants is now a classic and still holds its place as one of the leading books of reference on the Cobalt Camp.

GEOLOGY. The silver deposits of the Cobalt District are in pre-Cambrian rocks, most of the valuable ones in Huronian conglomerate, and a few in Keewatin greenstones and post-Huronian diabase. The

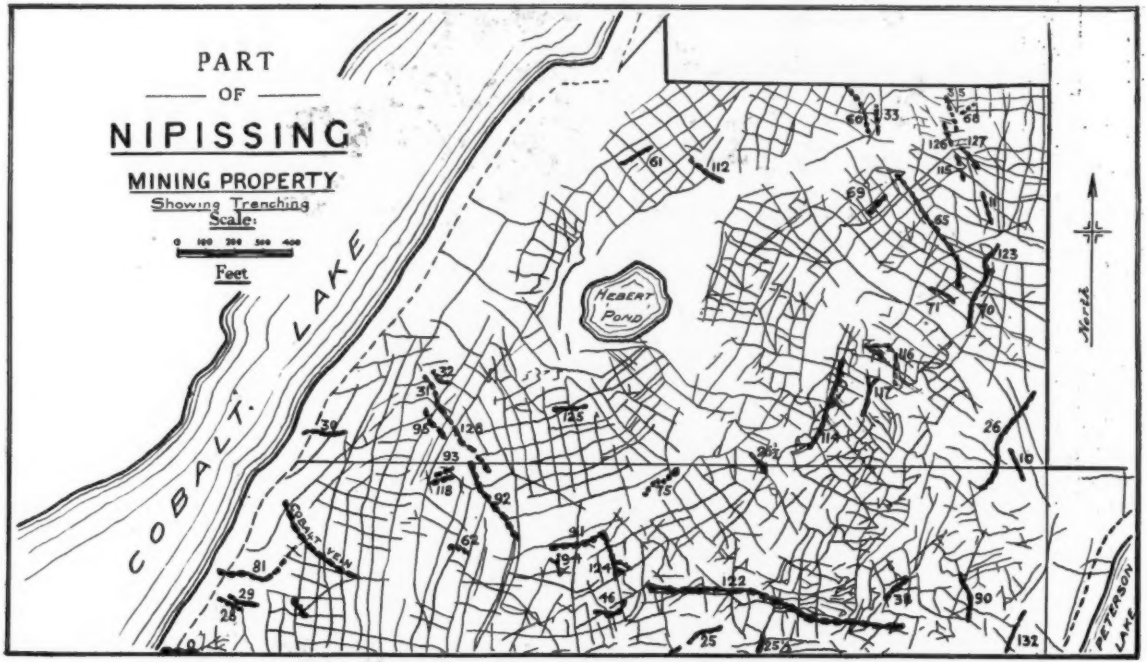
deposits are probably genetically connected with masses of the diabase, with which they are always closely associated.

The veins are generally nearly perpendicular and are narrow. They are worked from a half inch in width up, but the majority will be under four inches. The vein filling is usually calcite carrying native



RICH SILVER VEIN IN TEMISKAMING MINE; 400-FOOT LEVEL, IN KEEWATIN FORMATION.

Copyright, 1910, by A. A. Cole.



TRENCHING ON PART OF THE NIPISSING MINING PROPERTY, SHOWING SOME OF THE VEINS.

silver, associated with the arsenides of nickel and cobalt in varying amounts. Faults are numerous but the throw is seldom large.

The average depth of the cobalt-silver-bearing deposits is not great, and it would appear that the present veins are simply remainders, the original overlying and possibly greater parts having been eroded by glaciation. Undoubtedly some of the mines will find values at considerable depths, but these will be the exceptions to the rule. The salvation of the camp, however, lies in the fact that notwithstanding the shallowness of the deposits the veins are numerous.

SILVER VEIN IN CROWN RESERVE MINE, NEAR COBALT.
Width 14 inches; assay 9,000 ounces per ton; 100-foot level in Huronian formation.
Copyright, 1910, by A. A. Cole.

When Cobalt was in its infancy the lure of the wild came to people in all callings of life, and as the miner and prospector formed only an insignificant proportion of the population of the east, it was but natural that among those flocking to the new camp the beginner was much more in evidence than the experienced mining man. It was easy to distinguish between the men who had had some previous mining experience and others by the questions asked regarding mining claims. The former would enquire regarding the number and size of the veins, while the latter, particularly if from the rural dis-

TRENCHING, NORTH DRUMMOND LOT, KERR LAKE, NEAR COBALT.

tricts, the number of acres in the claim. It would now look as if the acreage tenderfoot was unwittingly not so foolish as he appeared to his more experienced brother worker.

PROSPECTING, TRENCHING. In opening up a property surface trenching is almost universally resorted to. Parallel trenches are run at more or less regular intervals, and these are joined up with cross trenches. The trench is dug down to bed rock, which is then swept and washed clean, and carefully examined for any signs of silver-bearing fissures. One of the best indicators is the delicate pink coloration of the cobalt bloom. When the ground proves productive the trenches are placed closer together. In the last annual report of the Nipissing Mine, the largest operating company in the district, the manager, Mr. R. B. Watson, says in speaking of trenching:

"This method of prospecting covers a large area at small expense and is far ahead of underground exploration as a means of finding new veins. At the present rate however, it would take many years to completely trench the property and then many veins would probably be missed.

"The only sure way to find outcrops is to entirely remove all the overburden on the rock surface, and preparations are now underway with this end in view."

The Nipissing Company alone during 5½ months of last year, dug 33 miles of trenches, averaging 3.4 feet deep.

MINING. Early shipments from the camp were made up almost entirely of ore taken from open cuts, but gradually underground development work was pushed, till now most of the ore comes from regular underground mining.

The shafts of the camp with one or two exceptions are vertical. The levels are sometimes placed 100 feet apart, but the distance is usually much less on account of the quick variations, both in value and in size, that take place in most of the veins.

The usual method of taking out ore underground is to run the drift or stope alongside the vein, leaving as much as possible of the vein on the wall, and then breaking down the vein by itself afterwards, and sacking a large proportion of the rich material at once. This mode of taking down the ore gives a minimum amount of fines, if the ore is not frozen to the wall. Another method that is now being introduced is to keep the vein in the centre of the breaking face. The advantages that are claimed for this system are (1) that only the men on the picking tables actually touch the ore; (2) the walls on both sides of the vein are prospected. With the other method only one

side is prospected and special work has to be done afterwards in order to test the other wall. The wall rocks frequently carry disseminated values and this makes it all the more desirable to take out the rock adjoining the vein on both sides.

Power Plants.

Power for the operation of the mines was until lately generated by coal and bringing in this fuel formed an important item in the business of the Government Railway. The shipments of coal into Cobalt for 1909 amounted to 105,416 tons.

Three water powers have been developed in the vicinity of Cobalt, aggregating about 16,000 horse power, and when this power became available in Cobalt the coal shipments dropped off almost entirely.

The three companies that have developed the water powers are:—

1. Cobalt Power Company.
2. Cobalt Hydraulic Power Company.
3. Mines Power, Limited.

The Cobalt Power Company has developed 3,000 horse power at Hound Chute on the Montreal River, six miles from Cobalt, and delivers power as electrical energy.

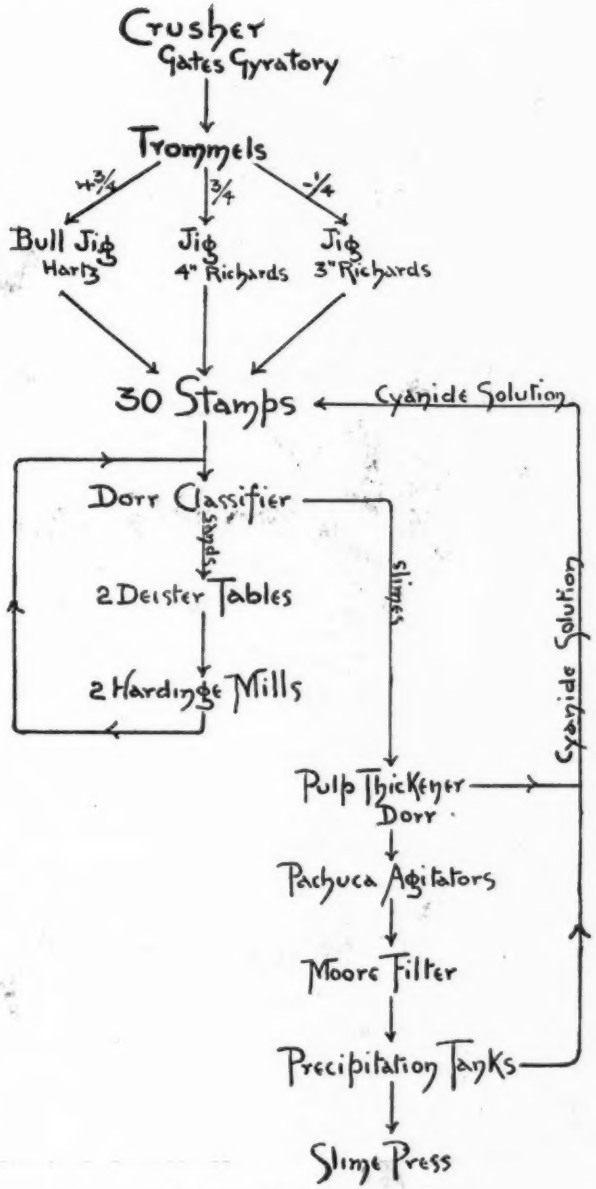
The Cobalt Hydraulic Power Company has developed 4,000 to 5,000 horse power at Ragged Chutes on the Montreal River, and compresses air by the Taylor system. The compressed air is brought to Cobalt through 9 miles of 20-inch seamless flanged steel pipe.

The Mines Power, Limited, has a capacity of 8,000 horse power, the generating plant being 22 miles from Cobalt on the Matabitchouan River. Power is brought into the camp as electrical energy and is there converted into compressed air by electrically driven air compressors.

The charges made by the above companies vary with different circumstances, but are about $50 per horse power per annum for electrical energy, and 25 cents per 1,000 cubic feet of compressed air at 100 pounds pressure and atmospheric temperature.

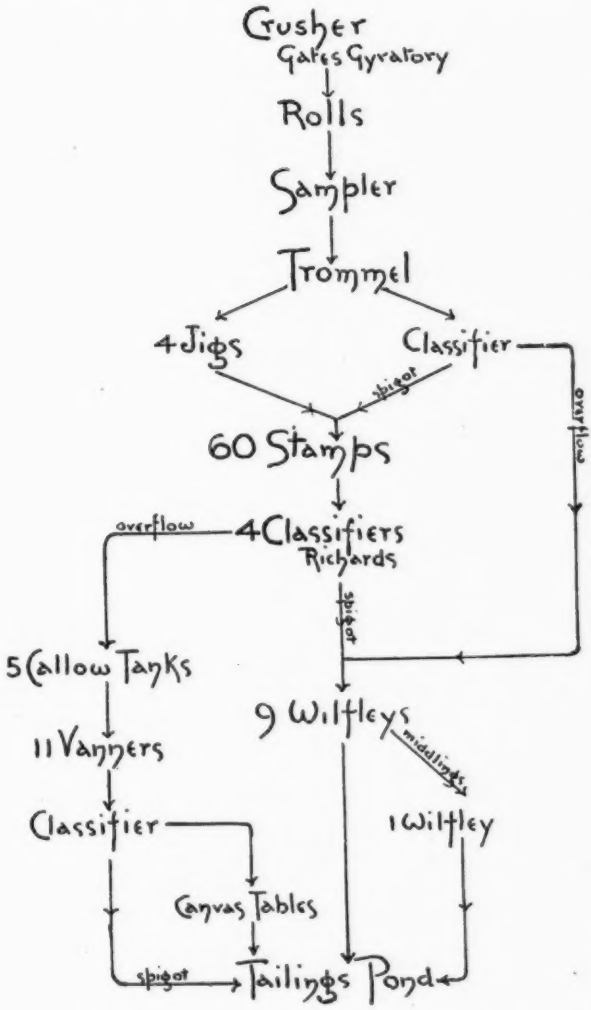
Concentration. There are at present thirteen reduction mills in operation in the Cobalt District; one more is under construction and others are contemplated. Ten mills use water concentration while the other three use more or less cyanide. The two flow sheets given below are chosen as types of the two classes of mills.

No two flow sheets are exactly alike, but this is what might be expected, as the ore varies greatly in physical characteristics, not only in the different mines but in different parts of the same mine.



FLOW SHEET, O'BRIEN MILL, COBALT.

TRENCHING, NIPISSING MINING COMPANY, OPPOSITE THE TOWN OF COBALT.



FLOW SHEET, NORTHERN CUSTOMS MILL, COBALT.

The great variation in the concentration ratio in the following table is due mainly to the different varieties of ore treated. For instance, the Cobalt Lake ore that was only reduced 5 to 1 was very heavy smaltite ore, while the Bailey ore that gave a reduction ratio of 68 to 1 was mostly native silver in diabase.

CONCENTRATION IN COBALT FOR 1909.

Mill.	Mines.	Ore Milled. Tons.	Concentrates. Tons.	Concentration. Ratio.
1. Buffalo	Buffalo	27,875.0	507.00	55-1
	Bailey	2,482.0	36.24	68-1
	Cobalt Central	21,272.0	362.40	59-1
2. Cobalt Central	Crown Reserve	45.0	1.02	44-1
	Foster	547.0	10.20	54-1
	Kerr Lake	1,093.0	104.79	10-1
3. Coniagas	Coniagas	19,671.4	465.70	42-1
4. Colonial	Colonial	1,500.0	25.00	60-1
5. King Edward	King Edward	4,769.6	105.43	45-1
6. McKinley-Darragh	McKinley-Darragh	18,703.0	741.59	25-1
7. Nipissing Red Co.	Nipissing	9,597.0	229.00	49-1
	Cobalt Lake	301.9	60.00	5-1
	City of Cobalt	2,576.3	57.01	45-1
	La Rose	5,988.2	255.62	23-1
	Nancy Helen	284.9	5.87	49-1
8. Northern Customs	Nova Scotia	1,173.1	39.71	30-1
	Right of Way	1,289.7	28.22	46-1
	Silver Queen	2,371.9	132.68	18-1
	Trethewey	1,130.8	17.02	66-1
9. O'Brien	O'Brien	3,749.5	57.00	*....
		126,421.3	3,241.50	†39-1

MARKET. During the first six months of 1910 Cobalt shipped 14,843 tons of ore for treatment as follows:

Canada	4,782.63	Tons, or	32.22	per cent.
England	153.65	" "	1.00	per cent.
United States	9,816.70	" "	66.13	per cent.
Germany	90.10	" "	.65	per cent.
Totals	14,843.08	" "	100.00	per cent.

It is noteworthy however that the three Canadian smelters handling Cobalt ores accept no low-grade material, so that while the tonnage treated by American smelters is greater than in Canada, the actual value of the ore refined in Canada is greater, being over 50 per cent of the total shipments.

CONCENTRATION. The tonnage milled during 1910 promises to be more than double that milled in 1909. The average extraction in the mills in the Camp is about 80 to 85 per cent, depending on the character of the ore and grade of the mill heads, at an average cost of about $3.00 per ton. The following table shows the proportion of the concentrates saved by the different parts of three of the mills.

* No comparative ratio can be stated for O'Brien, as all low grade concentrates were cyanided and yielded 12,656 ounces, which was shipped as bullion.
† The O'Brien is omitted from this ratio.

CONCENTRATES.

Mine.	Jigs. Per Cent.	Tables. Per Cent.	Cyanide. Per Cent.
Buffalo	52.39	42.69	4.92
Coniagas	40.60	59.40	...
McKinley-Darragh	53.70	46.29	...

The grade of ore treated will average about 25 ounces per ton, varying from 100 down to 10 ounces. Above 100 ounces per ton it will usually pay to ship to the smelter without further treatment.

PRODUCTION. The first silver discovery was made in the district in the fall of 1903, and the first shipment the following year. Since that time steady progress has been uninterrupted, as is evidenced by the following table:

Year.	Tonnage.	Value.
1904	158.55	$136,217.00
1905	2,336.01	1,485,570.00
1906	5,836.59	3,573,908.00
1907	14,851.34	6,155,391.00
1908	25,362.10	9,133,378.00
1909	29,942.99	12,356,442.00
1910 (6 mos.)	14,843.08	6,260,000.00
	93,330.66	$39,100,906.00

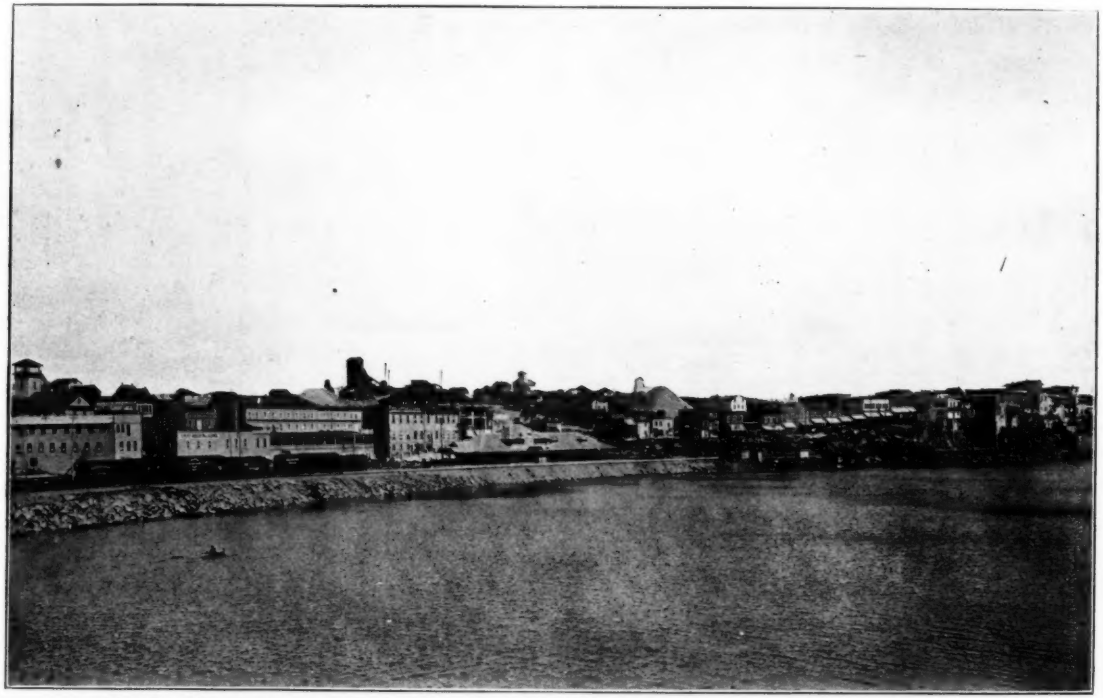
This easily places Canada in the third place among the world's silver producers, being surpassed only by Mexico and the United States in the order named. Only a small proportion of Canada's production comes from outside Cobalt. *Cobalt now produces one-eighth of the world's production of silver.*

MINING COSTS. The record of mining costs in Cobalt may be worked out as follows:

	Tons.	Value.	Dividends.
1904 to 1910 (6 mos.) ...	93,331	$39,000,000	$20,900,000

$$\text{Cost per ton} = \frac{18{,}100{,}000}{93{,}331} = \$194.00$$

These look like notoriously high working costs when compared casually with other mining camps, but if the shallowness, irregularity, and narrowness of the average ore shoot in Cobalt is taken into consideration it will be seen that the above really represents excellent mining practice.



PART OF TOWN OF COBALT, WITH HEAD FRAMES OF CONIAGAS AND TRETHEWEY MINES IN THE BACKGROUND.

The one condition that has the greatest influence on the cost of producing silver is the value of the ore. It costs nearly as much to mine a ton of 100-ounce ore as a ton of 10,000-ounce material. One of the richest of the shippers produced over 4,000,000 ounces of silver during 1909 at a cost of 10.31 cents per ounce. In making this calculation not only were all mining and marketing costs included, but office expenses, and 20 per cent was deducted for depreciation on buildings, plant and equipment. This of course is an exceptional case, but several others of the large mines are producing silver from 12½ to 22 cents per ounce. Taking the average cost per ounce of six shippers as 18 cents, and the average value of silver for 1909 as 51.5 cents, it will be seen that 33.5 cents are left to pay dividends. This makes it easy to understand why such an exceptionally large proportion of the Cobalt production can be paid back in dividends to shareholders.

Dividends. Viewed from a dividend standpoint the results achieved by Cobalt are unusually satisfactory. Up to the end of the first half of 1910 the total dividends paid amounted to well over $20,000,000; in other words, more than 50 per cent of the total production has already been paid back to shareholders of the shipping companies.

Two factors have been at work in 1910 which should further increase the proportion of dividends to total production, viz., the introduction of power from hydraulic developments, reducing the cost of production, and secondly the rise in the price of silver, which will increase the smelter returns. The average price of silver for 1909 was 51.50 cents per ounce. The average price for the first six months of 1910 was 52.65, or 1.15 cents better. This means an additional annual income of $300,000 for Cobalt.

Ore Reserves. A feature that has been misinterpreted by many people regarding Cobalt is the comparatively small ore reserves compared with the valuation put on the properties in the stock markets. In coming to a proper conclusion in this respect it is well to remember the circumstances under which most of the properties have been opened up. The ore was found rich from the surface, so instead of having to put in expensive plants to begin with, and to do extensive development work, the surface ore was taken out at once and realized on. Most of the directors of Cobalt mining companies were previously unfamiliar with mining and it was hard for the mine managers to get a chance to do any development while there was any ore in

sight. Pressure was constantly brought to bear on the manager to take out the ore just as soon as encountered. As a natural consequence several of the mining companies had bad temporary setbacks. Gradually better practise has prevailed, and for the past two years the ore reserves have gradually increased, notwithstanding a rapidly rising production, till now the ore reserves equal *two years' production at the present rate of output.* This is a higher level than the ore reserves of the camp have ever before attained, and indicates a very healthy state of affairs.

THE FUTURE. The physical condition of Cobalt was never better than at present. Systematic development is bearing fruit and numerous good finds are constantly being made. Thus during 1910 noteworthy finds of productive silver veins have been made on at least twelve of the shipping properties.

Faith in the stability of the camp for some time to come is evidenced by the amount invested in the district by interested companies. For instance, the amount invested in water-power development is more than $3,000,000, while the reduction mills of the camp have cost more than $1,000,000 to put in operation. The money for these has been put up by clear-headed business men, thoroughly familiar with conditions in the district. They realize also that if their investments are to prove satisfactory, both the principal and interest must be paid back during the life of the mines, and they are satisfied with the outlook. Flourishing little towns have sprung up in the neighborhood of Cobalt, dependent in large measures on the mines of Cobalt for their existence. Large and substantial buildings are being erected, and waterworks and other municipal improvements are going in.

Boom days are now over and the camp has settled down to a rational business level. This has caused the ever present pessimist to raise his head and recommence his wail of dismal forecasts for the future. Everyone knows that Cobalt cannot last forever, and even now the lame ducks are beginning to drop out of the flock. Nevertheless, Cobalt is now steadily producing more than *one million dollars* ($1,000.000) *worth of silver each month,* and the future is silvery bright.

Every year of the camp's existence has shown a larger silver production than the previous one, and 1910 promises to be no exception.

When in the future the Cobalt mines are worked out it will be found that the camp has totalled such a magnificent production that it will be entitled to a position in the forefront among the historical mining camps of the world.

COST KEEPING IN SMALL FACTORIES.

By Paul R. Powell.

Mr. Powell's purpose is outlined in his opening paragraphs. It is to formulate a cost system which will be well within the means of the modest plant, and yet supply information fully adequate to the needs of the business. He would thus put the small shop relatively abreast of the large one in exact knowledge of what it is doing, at an expenditure of time and money wisely proportioned to the amount of its turn over.—THE EDITORS.

TWO or three decades ago, when the demand for most commodities far exceeded the supply, the attention of business men and manufacturers was turned solely upon getting their orders filled, without taking time to seeing whether they were filled in the cheapest way possible. A firm would go over its books, perhaps once a year, and balance up its accounts to see how much money it had made. As the supply began to catch up with the demands, however, and competition became keener, the margin between gain and loss began to get so small that more attention had to be given to methods in order to do the work more cheaply. Thus it was found necessary to know the results of the business more frequently than once a year; so the accounts were cast up once a month and, as even this gradually became insufficient, the big companies began to install their elaborate cost systems which today tell them exactly where they are making money, almost to the hour.

This is particularly true in regard to manufacturing firms; many of the big ones know their costs of production, down even to how much it costs to drive a nail. It pays them to go into the matter so minutely because they drive so many nails that any improvement in the method, even of this simple operation, will net a saving that will more than offset the cost of the calculations. As these systems spread to the smaller factories they are often found to cost more than they are worth, and the managers give up cost keeping entirely, on the ground that their shops are too small to make it pay. They do not seem to realize that though they cannot afford to know the cost of driving nails, by combining this with sawing wood, etc., they can very easily

afford to figure the cost of the piece, and that to a degree of accuracy that will be of just as much value to them as the more intricate figures are to their big competitors. No firm doing work on a small scale can hope to go into the minute details that a big factory can, and make it pay; that is the advantage of the big organization which nothing can offset.

On the other hand, by combining these details, and further by combining the whole system with some of the other systems of the factory, such as the stock accounts and time keeping, a very satisfactory and inexpensive method of keeping costs may be reached. It would seem at first that this combining would lead only to greater complications than if the accounts were kept separate, but in a factory these accounts are so interwoven that ordinarily entries have to be made two or three times, that in the combined system need only be done once. In this way a great deal of time can be saved which will in part, if not wholly offset that used in cost keeping. I will describe below such a system involving a continuous stock account, time keeping, record of patterns, and a quick

Bin#_____ Name of Part-_____

Maximum number of pieces in bin-____
Minimum " " " " " -____

Date	Lot or Machine Number	Number of Pieces in Item.	Number of Pieces in Bin.

FIG. I. BIN CARD.

means of checking materials received with the orders as well as cost keeping and a record of the costs of the different materials; it is especially adapted to a shop employing from twenty-five to two hundred men and manufacturing a stock line of machines for the market.

Name- _____

Day- _____ Date- _____

Lot or Machine Number.	Operation.	Hours.
Total number of hours-		

FIG. 2. TIME CARD.

This system is kept on four sets of cards, the first two of which would be necessary to any shop whether it keeps costs or not. These are the "bin card" (Figure 1) and the "time card" (Figure 2); the former is an account of the number of each kind and size of part in stock finished and ready to be built into the machines, and is necessary to the manager in ordering new material. The latter is a regular time card and each workman makes one out for every day he works, stating the work he did and the number of hours; without this it would be impossible to pay off the men. The other two sets of cards are primarily cost cards, of which the first (Figure 3) gives the cost of making up each lot of parts and the second, (Figure 4) the cost of building and preparing for shipment each machine. The former is also used to check up orders for new castings, and as a record of the patterns, as well as the time and materials needed to finish the parts. The latter gives the time on building each machine and also constitutes a valuable record of the machine for future reference; this card may also be used for repair jobs with a very little alteration.

The first requisite, in fact absolute necessity, is careful co-operation on the part of the manager and foremen with the cost clerk in order that jobs may be pushed through and the shop kept in as systematic a manner as possible. No jobs should be left lying about the shop unless work is being done on them; all others must be returned

Name and Size of Part-_____

MATERIAL COST.

Material-_____

Date	—— CASTINGS.——	No.	Weight	Cost per lb	Cost
	Or'd from-_____				
	Rcd. from above-				
	" " "				
	" " "				
	Total received-				
	Returned (bad)-				
	" "				
	Net no. castings rcd.-				
	Pattern #_____ shipped.				
	" " returned.				

Date.	—OUTSIDE PROCESSES—	No.	Weight	Cost per__	Cost
	Sent to_____				
	for_____				
	Rcd. from above-				

Total materials cost-_____

Number of pieces spoiled-
Net " " " turned into stock _____

Lot #_____

LABOR AND TOTAL COSTS

Date	Operation	Workman	Hours	@	Cost

Total labor cost-
Overhead charges (____ percent of above)-
Total materials cost-
Total cost of lot-
Cost per piece-

Remarks-_____

FIG. 3. LOT CARD. FRONT AND BACK.

to the stock room. This evidently requires an enormous stock room, but it keeps the castings and other material where they can easily be kept in order, thus leaving the shop free for the work that is being done; and after all, the total space required is the same whether more or less of it is fenced into the stock room.

Size____ Style____ Machine #____

BUILDING

Date	Work Done	Workman	Hours	@	Cost

Total labor cost of building-
Overhead charges (__% of above)-
Materials cost of building-
Total cost of machine built-

SHIPPING

Date	Work Done	Workman	Hours	@	Cost

Total labor cost of shipping-
Overhead charges (__% of above)-
Materials cost of shipping-
Cost of machine built-
Total cost of machine shipped-

Remarks-

FIG. 4. MACHINE CARD. FACE.

For purposes of identification each lot of parts being worked on is given a "lot number," and each machine a "machine number." The lot number is marked on the castings or, if they are too small, on the box in which they are given out, in order that the lot may be kept together and that the workman may enter it properly on his time cards. The number of pieces in the lot should also be marked, thus making it impossible for the workman to avoid reporting any pieces he may spoil. The machine numbers are also for aid in making out the time cards and are stamped on the name-plates of the machines; they are of great assistance in looking up old machines on which repairs are to be made.

In the stock room every part has a bin, rack, or floor space where

Size_____ Style_____ Machine #_____

Building Materials						Shipping Material		
Date gotten out-								
No.	Part	Cost	No.	Part	Cost	No.	Part	Cost
Total-			Total-					
Materials cost of building-						M't'l cost-		

FIG. 4A. MACHINE CARD. BACK.

all completed pieces of that part are kept, so that the stock-keeper can find them the minute they are wanted. An account of the number of each of these parts is kept on a bin card, of which the first two columns are for the date and number of the lot or machine on which the item is received or issued, and the last two are for the number of pieces in the item and the resulting number in the bin respectively. At the top are spaces for the name of the part, the number of the bin, and the maximum and minimum number of pieces to be kept in it. The items are entered as the lots are received or the machines gotten out, thus keeping a continuous record of the number of pieces in the bin. When this number falls below the minimum enough new pieces are ordered to bring it up to the maximum, thus keeping it fluctuating between these limits, which are set far enough apart to require ordering once in two or three months. The limits may be varied from time to time as the amount of work done by the shop changes, for it is economy to keep only enough stock on hand to avoid delays due to shortages of materials.

For each lot of new parts a lot card is made out, on one side of which is kept a record of the castings as they come in, and when the total number in the lot has been received their cost is figured. Below this is kept a record of the pattern and any work that is done by outside firms; this is entered under the heading "Outside Processes" and the cost is added to the cost of the castings to get the total materials cost of the lot. At the bottom of the card is kept a record of the number of pieces spoiled in finishing and the resulting number completed and turned into the stock room. This side of the card, of course, will have to be modified for pieces that are not made from castings, or in many cases the cost items may be made out direct.

The reverse side of the card is simply an account of the labor done on the lot, and its cost; the first four columns are made out from the time cards. The column headed @ is for the cost of each man's work per hour, which is the sum of his wages and the cost of running his machine; this multiplied by the number of hours gives the cost of each operation, and the sum of these costs gives the total labor cost on the lot. "Overhead charges" is the allowance made for all those expenses that cannot be attributed to any one job; once a year the sum of these expenses is taken and reduced to a percentage of all the total labor costs of the year. This percentage is taken for the ensuing year, giving as accurate a division of the general expenses as is possible in a small establishment. The sum of the total labor cost, overhead charges, and total materials cost, which is taken from the other side of the card, gives the total cost of the lot, which divided by the number of finished pieces gives the cost per piece.

The machine card is kept in the same way. On one side is a list of the parts and their costs, which are taken from the lot cards, and on the other are the labor and total costs. The accounts for building and shipping are kept separate in order to determine the costs of each of those operations. It probably would not pay to have a set of these cards printed for every size and style of machine, so the list of materials is printed blank and filled in later with one of the many letter duplicators on the market.

This is the general plan of the system; of course the details will have to be worked out to fit the individual case. Perhaps also some of the principal features will have to be changed, but the simplicity of the system makes this very easy to accomplish.

THE DESTRUCTION OF THE BRUSSELS EXPOSITION.

THE photographs on the following pages give some idea of the completeness of destruction wrought by fire at the Brussels Exposition last August—destruction resulting largely from inefficiency of fire protection. According to reliable accounts, there was but one steam fire-engine within the grounds, and three or four engines worked by hand power. The fire companies from outside, most of them volunteer organizations, were under command of individual chiefs, and none could take orders from anyone else than its own commander, the consequence of course being almost hopeless confusion. The water pressure also was very inadequate, the stream in one typical instance reaching a height of but ten metres while the blaze was fifteen metres from the ground.

It is most interesting to note here again, as in many instances lately cited in these pages, that the inefficiencies can all be clearly identified and traced to violation of some one of the "Twelve Principles of Efficiency": lack of proper constructive organization, but in its place irresponsible power at the top—delegated duties and responsibilities without proper instruction—anarchy all down the line; lack of farseeing common-sense; lack of discipline; lack of standard appliances; lack of standard practice instructions.

The blowing up of the bridge shown on page 40 alone saved the whole of the Exposition from being destroyed. Thus, as elsewhere, in default of efficient provisions, destruction was met and overcome only by counter-destruction.

A PART OF THE OLD BRUSSELS GROUNDS. ONLY THE MAIN ENTRANCE AND THE RESTAURANT WERE SAVED.

THE BRIDGE CONNECTING THE BRITISH AND FRENCH SECTIONS. ITS DESTRUCTION SAVED THE WHOLE EXHIBITION FROM PROBABLE DESTRUCTION.

POWER REQUIRED FOR ROLLING STEEL.

By J. A. Knesche.

A description with data and results of original and carefully conducted tests on direct-driven plate mills, giving valuable figures of power consumption and a discussion of the elements affecting the power required. The present installment describes the apparatus and the mode of testing adopted. A succeeding part, in November, will publish the results.—THE EDITORS.

DURING the year 1907 I carried on a number of engine tests which had for their purpose the determination of the power required to roll steel. These tests were conducted at a considerable outlay of time and money, and it is thought the results from these investigations and the conclusions drawn therefrom will be of interest to many metallurgical men whose duties bring them into contact with the engineering phases of rolling-mill work.

At the start it was realized that in order to make these investigations of any practical value all data would have to be secured with the greatest possible accuracy. It was well understood that the greatest degree of accuracy could be attained by taking all data in an automatic manner. This, however, could not be done in the present case because the mills and engines on which these experiments were performed could not be set aside for experimental purposes only. All data had to be secured in such a manner as not to interfere with the regular operation of the mills.

DESCRIPTION OF THE MILLS.

The tests were made on four 22-inch three-high plate mills consisting of three stands of rolls, viz., one stand of three-high roughing rolls, one stand of three-high finishing rolls, and one stand of two-high finishing rolls. It will not be necessary to describe all four mills since they are all alike in general arrangement and dimensions.

Each mill is driven by a single-expansion steam engine, 36 inches by 48 inches making normally about 72 r. p. m. The shafts of the several engines carry flywheels from 20 to 24 feet in diameter which weigh from 60,000 to 65,000 pounds. These engine-shafts are directly connected to the mill driving shafts. The power is transmitted from the mill driving shafts to the rolls through pinions and

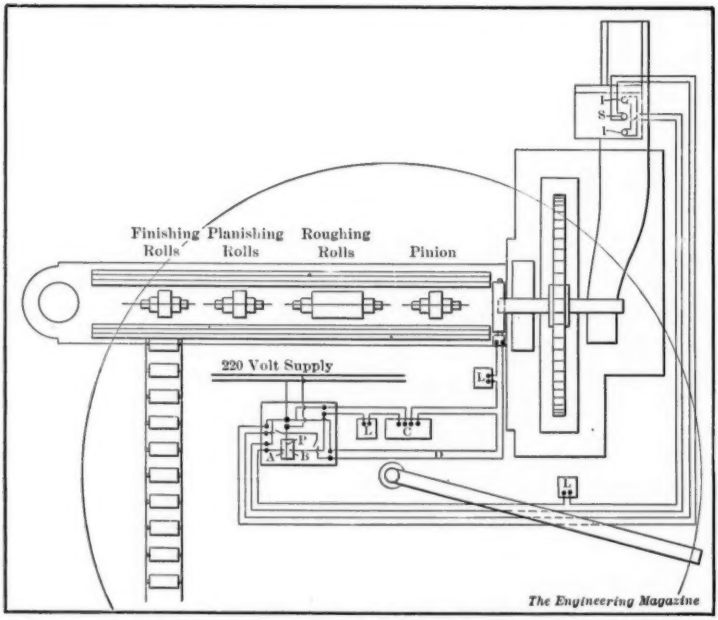


FIG. I. GENERAL ARRANGEMENT OF MACHINERY AND TESTING APPARATUS.

the usual muff connections. In general arrangement the lay-out of the mill and engine proper is as shown in Figure 1. This illustration shows also the instruments in place with connections.

Quantities to Be Measured.

As stated before, the purpose of these tests was to determine the power required in rolling steel. A further purpose was to develop a method by means of which the power required for any rolling mill about to be designed could be determined, when the rolling mill in question is to produce a certain tonnage under normal operating conditions. In order to accomplish this further purpose it would not have been satisfactory to find out merely how many horse power are required for the rolling of the given plates, because the results obtained from the solution in this manner of the problem at hand would be applicable merely to the rolling of shapes under conditions identical to those existing at the mill where the tests had been made. While it is very well to have such data, it is thought that the power required for a *unit of effect produced* in rolling-mill work will be of greater

service in the choice of the proper size of engine or motor for the mill.

From the above reasoning it was decided that if we know the power required to bring about the reduction of one square inch for the length of one foot, we will have a "unit of effect," so to speak, which answers excellently in the computations for the choice of the proper size engine or motor for the mill which may be under consideration. This unit of effect is expressed in the formula

$$\frac{W}{R\ L}$$

in which

W=the total work done on mill driving shaft minus friction load;

R=the total reduction in square inches from one pass to the next one, and

L=the length of the steel in feet after the pass in question.

I have chosen to call $\frac{W}{R\ L}$ "Constant C" in this discussion, because the work required to produce a certain effect under like conditions on like material should always be the same.

The unit of effect produced in rolling steel would not have to be expressed in the manner given above. Dipl. Ingenieure J. Puppe, who conducted very extensive investigations on many different mills and shapes of steel for the Committee on the Power Requirement for Rolling Mills, at the instance of the *Verein Deutscher Eisenhüttenleute,* uses the formula

$$\frac{(Q_1-Q_2)\ L_1}{E}$$

in which

Q_1-Q_2=the cross-sectional areas before and after any pass respectively;

L_1=the length of the piece before the pass, and

E=the energy expended on the pass in question.

It is readily seen that this formula is practically of a nature similar to the "Constant C" formula of the author. The German formula might be written $\frac{V}{E}$

V and E respectively representing the volume displaced and the energy expended during a certain pass. If this ratio is expressed in

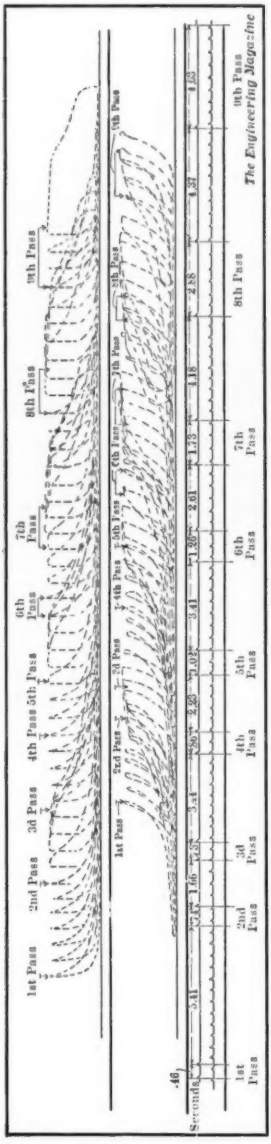


FIG. 2. SHOWING CONTINUOUS INDICATOR DIAGRAMS WITH DURATION OF PASSES, INTERVALS BETWEEN PASSES, AND EACH HALF REVOLUTION OF THE ENGINE.

cubic inches and horse-power seconds, the quotient would give the cubic inches which under the existing conditions can be displaced for every horse-power second of energy exerted at the mill driving spindle.

We will now return again to the quantities to be measured in these tests. In the numerator of Constant C for a given test, W represents the energy expended; this quantity may be and usually is made up from two sources—from the energy of the steam in the engine cylinder, and from the energy given out by the flywheel.

The power developed in the engine cylinder was determined by means of continuous-diagram indicators. Two such instruments, electrically controlled, one for the head-end and one for the crank-end of the engine were used. Sample diagrams are shown in Figure 2. In discussions on this subject of rolling mills operated by electricity and by steam one finds frequently a great deal said about the unreliability of rolling-mill engine tests where a steam-engine indicator must be employed to determine the energy furnished by the engine cylinder; on this point I shall have something to say later.

As stated before, the numerator of Constant C is made up of the energy given out by the steam in the engine cylinder and of the energy given out by the flywheel. In order to figure the energy furnished by the flywheel, the weight of the flywheel entering into the computations and the speed of the wheel both immediately before and

after the pass must be known. Arrangements must be made to measure the speed of the revolving masses with great accuracy at the periods mentioned. For this purpose a chronograph with electric pen movements was employed. The instrument used is shown in Figure 3.

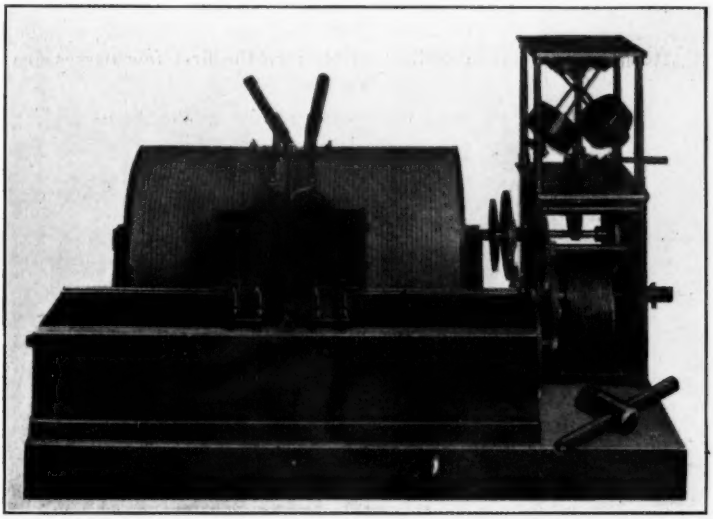


FIG. 3. CHRONOGRAPH WITH TWO ELECTRICALLY OPERATED PENS.
One pen was used to record the beginning and end of pass and interval; the other, to record each half revolution of the engines.

From the illustration it will be noticed that the chronograph carriage has two pens. One is used to record the length of time of each revolution of the engine, while the other pen records the beginning and the end of every pass. A chronograph record sheet is shown in Figure 4. During the test one pen was filled with red ink and the other with black ink, to distinguish readily the revolution record from the record of the length of time of the different passes. The designations 1A, 2A, 3A, 4A, etc., refer to the first, second, third and fourth passes of billet "A." The engine-revolution records belonging to each billet are pointed out by the arrows.

The home-made device shown in A in Figure 5 was used to cause the automatic revolution records to be traced on the chronograph drum. From the illustration its construction and manner of appli-

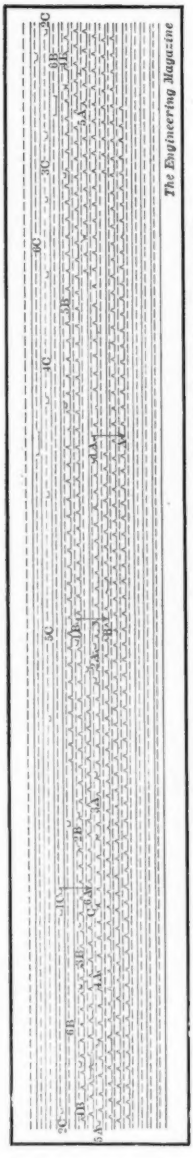


FIG. 4. CHRONOGRAPH RECORD SHEET. A, B, AND C REPRESENT SEPARATE BILLETS. The points of the arrows are resting on engine-revolution records, while the other ends of the arrows indicate the beginning of the first pass. 1A, 2A, 1B, 2B, 1C, 2C, etc., indicate the different passes for billets A, B, and C.

cation are readily seen. In the preliminary experiments (of which it was necessary to make quite a number before all instruments were in perfect working order and before the observers were sufficiently trained), only one contact piece, insulated properly, was placed on the engine shaft and mill-driving spindle coupling. But since the first few passes are of less than one second's duration, it became necessary to place another contact piece on the above-mentioned coupling so as to be able to measure more accurately the duration of these first passes. The center of this second contact piece was placed at an angle exactly 180 degrees from the center of the first contact piece, and in this manner the chronograph record gave the engine speed for every one-half revolution. Figure 5 shows how the properly insulated contact pieces were placed on the coupling.

By using a strong magnifying glass it was possible to measure the distances between the individual record marks easily and accurately to within 0.005 inch. Since with the fast speed of the chronograph the surface of the drum moved over the distance of 0.61 inch per one second, 0.005 inch meant that the time readings were accurate to within less than 0.01 of a second. The chronograph was calibrated before and after each test, the conditions being the same as those which prevailed during the test; this was done because the platform in the mill on which the instruments were located vibrated slightly when all the heavy rolling-mill machinery was in operation.

The speed being known before and immediately after any pass, and all flywheel dimensions, the energy either given out or stored during that pass is readily determined from the formula

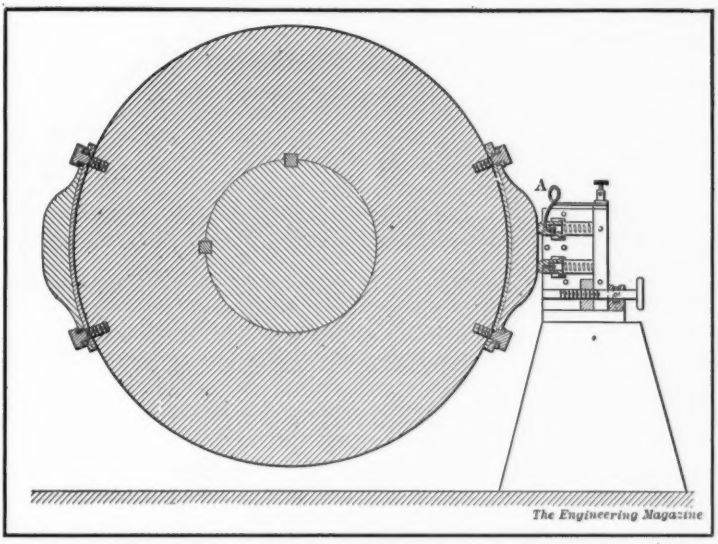


FIG. 5. DEVICE FOR CAUSING REVOLUTION RECORDS TO BE TRACED ON THE CHRONOGRAPH DRUM.

$$E = W_f \frac{V_1^2 - V_2^2}{2g}$$

in which

E=the energy in foot-pounds.

W_f=the effective weight of the flywheel which stores energy. In the case of these tests the weight of the rim plus one-third of the weight of the arms and the hub was taken as the effective weight of the flyweel.

V_1 & V_2=the velocities at the end or the beginning of a pass.

W in $\frac{W}{R\,L}$ may be written

$$W=[(E_c + \text{or} - E_f) - F]$$

in which

W=work in foot-pounds done during the pass.

E_c=foot-pounds of work done in the engine cylinder during the pass, determined in the usual manner from the indicator cards.

E_f=energy paid out or stored in the flywheel during the pass expressed in foot-pounds. This quantity is positive if the energy is paid out by the flywheel; negative, if it is stored in the flywheel.

F= the friction load at the proper speed expressed in foot-pounds; this quantity was determined from the indicator cards when the engine was driving the empty mill at constant speed.

"R" (reduction) and "L" (length) of the quantity

$$\frac{W}{RL}$$

pertain to the dimensions of the steel after the passes in question. If the original weight is known, and if further one of the quantities L or R is known, the other quantity can be readily computed. In these tests R is measured and L is figured. The greatest care was exercised in obtaining the correct figure for R. After all the rolls, including the finishing rolls, are set correctly, they remain thus under normal operating conditions. When a sufficient number of continuous-indicator cards, time- and chronograph-records had been taken, and without making any change whatever on the roll setting, enough billets were passed through the rolls to get the measurement for R for every pass. To explain more fully; in order to get R for the first pass, a billet was taken through the first pass, pulled aside, and permitted to cool; to obtain R for the second pass, a billet was sent through the first and the second passes; for R for the third pass, a billet was guided through the first three passes, etc. When thus a billet had been obtained for every pass, and when these billets had become cool, the width and thickness were carefully measured with micrometer calipers at anywhere from twenty to one hundred places, and the average of all these readings was taken in the determination of the areas. The difference between the areas of any two consecutive passes gives us R in square inches.

One objection to this method of obtaining R is the fact that the temperature of the hot steel may not be the same for like passes and on this account R may be greater or smaller than the R for the billet and pass for which the indicator- and time-measurements were made. This error, however, is considered insignificant, since under the conditions of operation it would be in the third or fourth decimal and therefore negligible.

From Figure 1 is evident both the manner of obtaining data and the electrical connections. Owing to the fact that no suitable storage batteries were at hand, the magnets on the instruments were replaced by others with greater current capacities and connection was made with suitable lamp-banks in series to a 220-volt circuit. The panel

board had mounted upon it a small single-pole double-throw switch, P, the closing of which placed either the indicators II or, the chronograph C in circuit.

The chief-observer's station was on an elevated platform about fifteen feet in front of the rolls. About a minute before the test actually began, chronograph circuit D was closed, thus recording every one-half revolution of the engine. When the billet was brought to the mill, and perhaps five or ten seconds before it was entered, the chief observer indicated through the signal lamp S, to an assistant stationed at the engine cylinder, that the paper-moving devices of the indicators were to be put into operation. When the billet was beginning to enter the rolls, switch P was brought into instantaneous contact with B and was then at once thrown against A and held there until the end of the pass. The instantaneous contact with B marked on the chronograph sheet the beginning of the pass, while the contact of the switch with A closed the indicator circuit and thus caused the indicator diagrams to be traced. At the end of the pass, switch P was thrown against B again and returned with the greatest possible speed to A. Pulling the switch P away from A for a moment and returning it again caused a break of about a half an inch in the indicator diagrams, thus marking on the indicator cards the several passes and intervals. The chronograph gave the length of time of the intervals and passes; also, in addition, the revolutions in those periods, thus affording a check on the passes and intervals as marked on the indicator cards.

One objection which might be urged against obtaining the time-readings in this manner is that as a matter of course some small interval of time elapses in throwing the switch P. While this is true, it is likewise true that this small interval of time (not more than one-tenth of a second, perhaps), elapses with every throw of the switch and therefore the individual time determinations for passes and their intervals must be correct. These time determinations may of course occur one-tenth of a second after they actually took place, but since all records, including those for the indicator diagrams, are this much behind the actual instant of occurrence, this slight retardation in making the records introduces no errors.

Influence of Temperature in Rolling Steel and Pyrometers Suitable for Work Under Discussion.

The temperature existing during the rolling of the steel is of vital influence on the power required. This is of course so well-known that it could be passed over without comment. But since in

these tests the temperatures of the hot steel were not measured at all, it is thought mention should be made of the reason why the taking of these important data was omitted.

At first it was intended to measure the temperatures during the different passes by means of an experimental thermo-couple, but this proved entirely unsuitable for the work at hand. As no other pyrometer could be secured it was necessary to make the experiments without such instruments.

From a study of the nature of the work and the surrounding conditions, it becomes evident that a pyrometer with a thermo-element is not suitable for the work at hand. An optical pyrometer alone can be used. The requirements to be fulfilled by an instrument which is to be used to determine the temperature of steel in rolling-mill work after every pass, are accuracy and rapid adjustment. It would also be of great advantage if the instrument were portable, but this is not absolutely necessary.

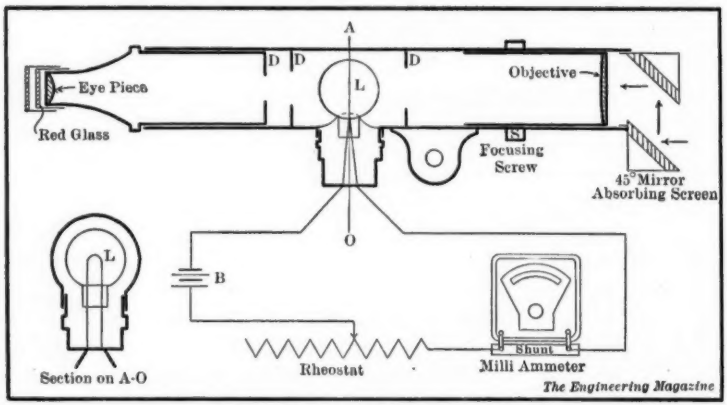


FIG. 7. HOLBURN-KURLBAUM OPTICAL PYROMETER.

The instrument which I consider excellently suited for this work is the Holburn-Kurlbaum optical pyrometer, a diagrammatic sketch of which is shown in Figure 7. It consists of a small 4-volt incandescent lamp, L, with hair-pin filament, and is mounted in the focal plane of the objective and of the eye-piece of a telescope provided with suitable stops, D, D, D, and with a focussing screw S for objective. The lamp-current is completed through a two-cell storage battery, B, a rheostat, and a milliammeter.

The determination of a temperature consists in focussing the instrument upon the incandescent object, thus bringing the image into the plane A C, and adjusting the current by means of the rheostat until the tip of the lamp filament disappears against the bright back-ground. From the reading of the milli-ammeter the temperature can be found from a previous calibration of the lamp giving the relations between the currents through it and the corresponding temperatures of a radiating black body. Each calibration is independent for different lamps used.

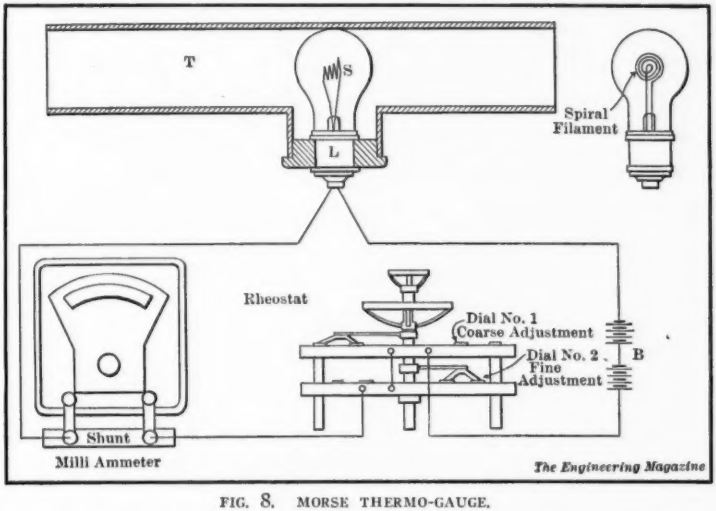


FIG. 8. MORSE THERMO-GAUGE.

The low limit for this instrument is 1,150 degrees F.; with a temperature of 1,500 degrees F. a red glass must be placed before the eye-piece to avoid the blinding effect of a brightness too great for the eye. This instrument is manufactured in Germany by Siemens & Halske.

Another instrument which might be used with equal success for the rapid determinations of temperatures of steel is the Morse Thermo-Gauge, manufactured by the Morse Thermo-Gauge Company. It is based on the same principle as the Holburn-Kurlbaum optical pyrometer, but owing to some slight difference in construction it is perhaps a little less sensitive. However, it may be read to within 5 degrees of the actual temperature, and this would of course be sufficiently accurate for the determination of temperatures in rolling-mill

work. A diagrammatic sketch is given in Figure 8, the method of use will be shown in Figure 40.

To my knowledge the Wanner optical pyrometer has been used with success for temperature determinations in rolling-mill tests. One disadvantage of this instrument is that it can not be used below a temperature of 1,650 degrees F., and for the work in question this is a serious drawback. A sketch of the Wanner optical pyrometer is shown in Figure 9.

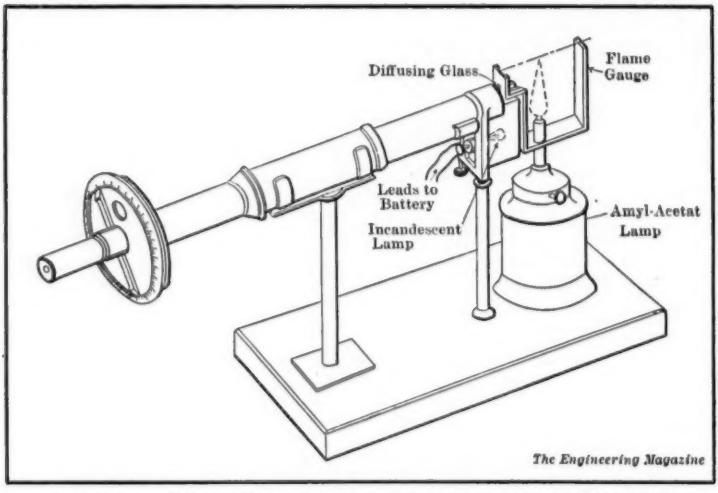


FIG. 9. WANNER OPTICAL PYROMETER IN POSITION FOR STANDARDIZING.

I know of a case where the Mésure and Nouel pyrometer telescope was to be used in accurate temperature determinations in rolling-mill tests. A section of the instrument is shown in Figure 10. This instrument has found its widest use in the ceramic industries; its lower limit is about 1,375 degrees F. While this pyrometer replaces the unaided eye to great advantage, it is not sufficiently sensitive for accurate temperature determinations in rolling-mill work. Without entering into a lengthy discription of the instrument, it is sufficient for the present purpose to state that even after considerable practice an observer can not be sure of his readings to better than 120 degrees F. at temperatures above 1,800 degrees F.

Considerable space has been devoted to the consideration of pyrometers useful for this work under discussion and we will now return to the subject we started out to discuss, *viz.*, the important part which the temperature of the steel plays in rolling mill work.

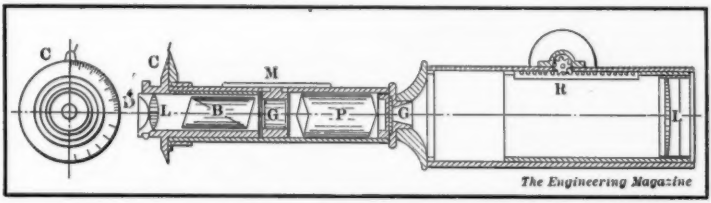


FIG. 10. MÉSURE AND NOUEL PYROMETRIC TELESCOPE.

From careful observation we soon learn that the greater the ratio of surface to sectional area, the greater will be the rate of cooling per certain time, and the greater will be the power requirement per given reduction. While my experiments were confined to comparatively thin plates, only I believe it to be a safe conclusion to state that the power required per square inch reduction per foot length of piece will be less in the case of a heavy ingot than is the energy required in the case of a comparatively thin plate, both rolled at the same temperature. I believe this to be due to the fact that while the surface temperatures as measured with an optical pyrometer may nominally be the same in both cases, yet the actual average temperatures would not prove to be the same if measurements could be made at different points across the section, as at a, b, c, d, in A, Figure 11, and at the points a, b, c, d, e, f, g, etc., in B, Figure 11.

By reason of the greater radiating surface per certain volume in A as compared with that of B, the temperature at the points a, b, c, d, etc., in A, would be practically that of the surface s, s, of that

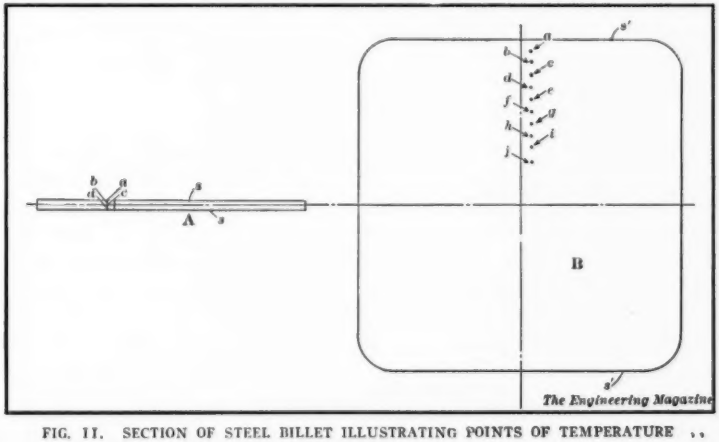


FIG. 11. SECTION OF STEEL BILLET ILLUSTRATING POINTS OF TEMPERATURE MEASUREMENT.

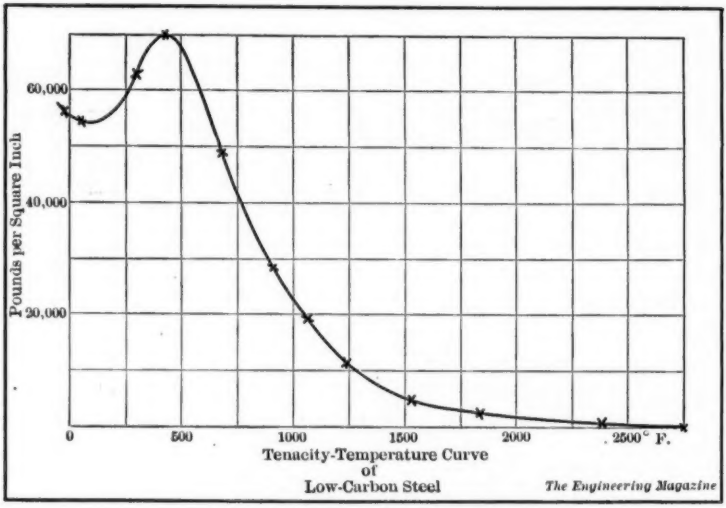


FIG. 12. TENACITY TEMPERATURE CURVE.

shape; while in B the points lying towards the center of the cross-section would have a considerably greater temperature than those in s, s. Therefore, since in measurements of steel temperatures with the optical pyrometer we speak of surface temperatures only, it is readily seen that at the same temperatures the power requirement per square inch reduction per foot length of piece would be greater in a section of the shape of A than in a section of the shape of B. For this reason it follows that if the power required for rolling a plate is to be determined, it would not be strictly correct to chose the Constant C curve of a heavy ingot.

In connection with subject under discussion the "Tenacity-Temperature Curve" in Figure 12 is also offered. Theoretically, in rolling hot steel the resistance offered by the steel against its permanent deformation, or what in our case is practically the same, *viz.*, the power required in rolling, changes in a manner similar to that in which the ultimate strength of steel changes at different temperatures. It is a known fact that the ultimate strength of the steel changes according to the temperature. It is generally known that if a piece of steel is heated its ultimate strength becomes less. In Figure 12 is shown this decrease of ultimate strength with increase of temperature. If we compare the curve in Figure 12 with the Constant C

curves at the proper temperatures, mentioned later more in detail, we note a striking similarity in these curves. We would naturally expect this to be the case. The tenacity-temperature curve and the ideal Constant C curve would no doubt be closely parallel if it were possible to eliminate all irregularities due to the changing friction loads of the mill and the changes in loads due to roll-pass friction.

The conclusion of this paper, which will be published in the following (November) issue of THE ENGINEERING MAGAZINE, will present the results of the tests in a series of tables, followed by a discussion accompanied by curves and diagrams. To this will be added an analysis of the influence of the material and the size of the rolls upon the power required, and of the principles of design thus deduced. The last section of the paper deals with the cost of power in rolling mills, and with a comparison of the accuracies obtained in steam- and electric-driven mills respectively.

SYSTEMATIC FOUNDRY OPERATION AND FOUNDRY COSTS.

By C. E. Knoeppel.

I. THE TWO GREAT FORCES INVOLVED IN MANUFACTURING.

With this initial paper of a new series, Mr. Knoeppel returns to the study interrupted two years ago. The following articles will have the advantage not only of fully digested thought but of very valuable investigations and experience accumulated in the interim. While the first interest is the foundry, the principles and methods defined are equally applicable to the machine shop, the forge shop or smithy, and the structural steel works. Mr. Knoeppel's article next month will deal with the Principal Elements of Foundry Management and Accounting.—THE EDITORS.

IN continuing the series of articles on the above subject, begun in the October, 1908, issue of this magazine, it might be well to outline the purpose of this second section. This will be to go into the details necessary to explain the practical side of foundry accounting and foundry operation, and to illustrate as far as possible the principles laid down in the preceding papers, which discussed:—

1. Foundry Accounting as a Problem.
2. The Importance of Correct Burden Apportionment.
3. The Elements Entering into Foundry Production Costs.
4. The Importance of Comparative Elements.
5. Treatment for the Various Classes of Foundries.
6. Foundry Organization and Management.

This series will take up the discussion of the two great forces which should be harmoniously united in every business—the "analytical" and the "constructive"; the principal elements entering into accounting and management; production and its details; labor costs; material costs; costing; statements, records and charts; predetermination of costs and the "efficiency movement."

It is extremely doubtful if the accountant of a hundred years ago would recognize the present-day accounting practice. He certainly would be in no position to appreciate immediately the progress that has been made since his day, owing perhaps to the fact that he would be lost in the maze of bound books, loose-leaf devices, card systems, mechanical aids, controlling accounts, short cuts, special rulings, billing machines, and a hundred and one other things which go to make

our Twentieth Century accounting practice. He would admit, after he became familiar with the methods practiced, that wonderful progress had been made since his time; but he would also be impressed with the fact that many accounting schemes, considered excellent, seriously approach the "worth next to nothing" point.

There are a number of reasons for this. In many cases, the accounting is a mere jumble of figures, which have little or no value as a guide to the executive. In others, vital information is compiled only *once a year,* or if an attempt is made to furnish monthly statements, they are furnished so long after the close of a month, that the information contained in them represents so much waste effort—they are furnished too late to enable the executive to point out the reasons for certain inefficiencies. Then again, accounting schemes may furnish information without regard to the requirements of the business in question; or they may be changed materially from time to time, elaborated upon, "boiled down," new features added, others cut out—each new bookkeeper introducing a few "stunts" of his own, until he gets things to run his own way. Between all this and accounting schemes sold in "chunks," and further the willingness of each auditor or accountant that comes along to point out where the accounting fails to furnish the required data—where it violates the rules of standard accounting practice—the scheme in a short time becomes hopelessly confused, rendering intelligent comparison absolutely out of the question. Is it any wonder that a manufacturer, after going through such an experience, is far from being in a receptive attitude when "accounting system" is mentioned to him?

To present the right kind of information in the wrong manner is confusing and unsatisfactory. To present the wrong kind of information in the right manner is misleading and dangerous. It would be far better for many simply to keep track of the cash on hand and what is due and owing, than to maintain an elaborate accounting arrangement which does not result in an accounting that can be used in bettering the business. A scratch pad, a pencil, and a good guess would be just as efficient. The *right* kind of information, *rightly* presented, is therefore the problem.

As a declaration of principles, let us decide at the outset that an accounting scheme to be efficient must first of all consider the needs of the business in question; that it must be comprehensive, proceeding on the broad assumption that information should be given an opportunity of working for the executive—not a burial which may have no resurrection; that it must be designed to anticipate the needs of the

executive in every possible way; that it must be planned not only to make possible a rapid comparison and analysis of the various elements, but to serve as a statistical bureau as well; that the accounting *must be simple* to admit of its being easily understood and quickly operated, in order that there may be no delay in getting the pertinent facts to the executive promptly; that it must be arranged so the unnecessary work and entries will be done away with, in addition to which it should be designed to furnish information *during* the month —a point of importance to every manager. Current information is of far greater value to an executive than data six to eight weeks old; furnishing figures of the latter sort is a fault which has done more to discredit modern accounting methods than perhaps any other one thing. The underlying thought should be not "what have we done" but "what have we done and what are we doing" from which an executive is in a position to answer "what can we do." At any rate, an accounting scheme which measures up to the above standard is entitled to consideration, for as a matter of fact, one of the possibilities in foundry accounting is *better and more complete information in quicker time and at less cost than is usually the case.*

There can be no question, however, if one stops to review the past, that there has been and is now, on the part of a great many, altogether too much dependence placed in mere cost records and figures; for while they are necessary and of the utmost importance, they must not be considered as being the only means to a desired end. A great many are satisfied when their cost figures inform them regarding the disposition of their money, in addition to which the figures may be used as a check on their selling prices. Others go a step further and use their information as a basis for comparison between operation and operation, or of completed unit with completed unit, in order to detect fluctuations in an endeavor to keep costs down. Others use their figures for carefully checking up the departments, foremen, machines, operations, men, etc., in order to reach some conclusion, even if not altogether accurate, as to the efficiency of their plant. Still others have definite estimates or standards against which the actual preformances are checked. How many are there, however, who use their facts and figures for all the purposes mentioned? As a matter of fact, if all were using all of them, they would be bringing into play what I have termed and defined in my preceding papers an "analytical force"—a process enabling them to apply remedies when their information developed the fact that certain places needed prompt attention.

An equally important force can be employed with as great if not greater results—on which can be fittingly termed a "constructive force," a building up process—which acting in harmony with the force just mentioned, finds ways and means to *anticipate* as far as is possible the leaks and faulty conditions. One force is as vital and necessary as the other, although it is true, and unfortunately so, that very few get all the good possible out of both of them. Whether employed separately or together, they are made up of the following steps:—

1.—Securing data.

2.—Recording the data secured.

3.—Compiling the data in convenient shape for reference and study.

4.—Reasoning applied to the compilations.

5.—Conclusions based on the reasoning.

6.—Action in some definite direction.

7.—Results.

The principal difference is that the analytical force is concerned with figures and statistics showing *what has been accomplished, as a guide to future action and results,* while the constructive force is concerned with facts and information as to equipment, conditions, operations, men, etc., showing *what should be accomplished in order to secure results.* One force will of course do a great deal of good without the other, perhaps because of the fact that there remains, in modern manufacturing practice, a great deal to be done, but it should be seen that the two forces mentioned, working harmoniously along widely different lines with the same goal in view, will accomplish more in the way of results than either of the forces working independently.

Mention was just made of the fact that a great deal remains to be done. How true this is no one knows better than those whose profession it is to assist in getting all that is possible out of men, equipment, and materials, and who are in a position to see, through close observation, where the faults lies and what will eliminate them. There is a task ahead of this great nation—a task so great as to warrant wise executives giving it earnest and careful consideration, as well as to attract the attention of those who are in a position through training and natural ability to assist in solving its many problems—*that of increasing the efficiency of all human endeavor.*

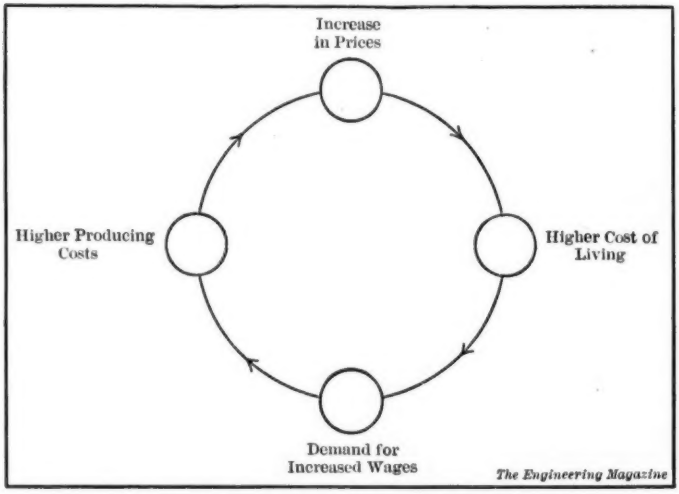
We have graft and investigations of one kind or another until it would seem that there remained no such thing as civic pride; we hear on all sides constant reference to "high cost of living" with innumerable reasons why; we hear that railroads must raise their rates in

order to protect themselves, to which the shipper strenuously objects as any such increase affects cost of production which would mean still higher prices; we see sufficient evidence of a far from diminishing dissatisfaction among the laboring classes resulting in constant strife between capital and labor. These and many other conditions which could be mentioned furnish sufficient evidence that something is decidedly wrong—that we are face to face with conditions which cannot exist continuously without disastrous results.

This condition of affairs has been most excellently expressed by H. L. Gantt in his paper "Prices and Profits" which appeared in this magazine a short time ago:—

> With increase of prices comes higher cost of living; with higher cost of living comes demand for higher wages; with higher wages comes higher cost of production. Then to maintain the same profit under the new conditions, we must again increase our selling prices and the cycle repeats itself.

This vicious cycle is illustrated graphically by the chart below.



THE VICIOUS CYCLE OF INCREASING PRICES AND COSTS.

What is the trouble? To me, two great faults seem to be responsible: first, *extravagance* and second, *impatience*. The wide-spreading movement for the conservation of our natural resources is sufficient evidence that as a people we are extravagant, and no one, after due consideration, will deny the fact that in our hurry to get things done—to see results—to turn time and material into cash, impatience is

largely responsible, both faults being the result of our present system of organization and management, as will be evident to anyone who will take the time to read carefully the series of papers by Harrington Emerson published currently in this magazine, on "The Twelve Principles of Efficiency."

As a people we have come to the national realization of the importance of conserving our natural resources, and as a result we now have this matter as one of our lively issues, forcing the attention of our able men. What we need, however, and *at once,* is a movement for the conservation of our resources other than water power, minerals, timber, etc., which would mean decided benefits. This would involve:

1.—Increased production.
2.—Lower production costs.
3.—Decrease in prices.
4.—Lower cost of living.

} as an offset to the condition pictured in the chart.

What we need most of all is to hear more about *inefficiency* and less about efficiency. Most of us seem to like the latter word so well that we use it without much thought as to its real meaning. If we talk about the inefficiencies more, our efforts towards eliminating them will be increased, and efficiency, as a natural result, takes care of itself. Inefficiency is an unhealthy state of affairs—a disease in other words—just as susceptible to diagnosis and treatment as any unhealthy condition. If diagnosis and treatment are withheld, however, *decay and death is the result*—a law which is no different in its relation to the industrial body than to the physical body.

Efficiency in the best acceptance of the term means more than simply doing things well—I might say, *thinking* or *guessing* that they have been done well; it is the *positive relation or ratio* between a possible accomplishment—an ideal, a standard—with the actual attainment. We have had altogether too much imagined efficiency and not enough of the cold, mathematical, relative determination. The great trouble has been that standards have not been properly set, or if set no consistent effort is made to assist those responsible for results in attaining them. Consequently we have accomplishments that are not what they should be, which if reduced to a relative basis would show that inefficiencies are still "on the job." For this the management of the enterprise is largely to blame. Instead of beginning at the *bottom* and setting standards for each and every part of the work—whether it be operation or condition— entering into making a business successful, they begin at the *top* and fix in their own minds a final standard as regards what they *want* accomplished, after which they promptly proceed to unload all responsibility onto the shoulders of others—

everyone all along the line, down to the workers themselves, having a hazy idea as regards what is really expected of them; and as "anybody's task is nobody's work" it stands to reason that the final attainment cannot measure up to the expectation. This however does not seem to relieve those who have failed to accomplish what was wanted from their share in the session "behind closed doors."

In recent years, a great deal of attention has been devoted to "waste products"—a number of establishments having their own corps of experts, who do nothing but analyze and study the wastes previously considered as possessing little or no value, with the result that the markets today are filled with "by-products" of every kind and description producing a revenue which pays excellent dividends on the cost of their marketing.

In all industrial pursuits, there are many wastes which can be made to yield satisfactory returns. Careful investigation in the majority of institutions will soon develop the fact that the chief wastes are due to time losses, wasted materials, too much equipment, lack of intelligent planning, poor and insufficient facilities, equipment improperly maintained, etc. A costly bridge is erected, not because it was impossible to cross before but because crossing is facilitated and made easier with the bridge than without it, and as a result all share in the benefits. If, then, we place a force at work which will turn the wastes into products, we erect a structure which enables the consumer as well as the maker of the products to share in the benefits that always accrue through turning out more in less time.

This "constructive force" is one that is distinctly up to the management of an institution, and it might be well to outline in a brief, general way, what an organization should be and do in order to utilize the possibilities in the wastes.

A successful organization is one which considers the fact that this "constructive force" is a building force, and as it takes time to erect any structure, results must not be expected in a minute; that it should be composed of men who can give their time and attention to the careful study of the wastes, or be assisted by men who are expert in analyzing and bringing up for attention the weaknesses of the industrial body; that the hearty co-operation of the ones who own and operate the business is vital and necessary, in carrying to a successful issue the proposed ways to greater results. It should first see that the working conditions are what they should be; that the equipment is placed in the best possible shape for maximum production; that the men are furnished with the best facilities in order to enable them to take every advantage of the improved conditions and equipment; that the work,

in its various details, is planned ahead and scheduled so that delays and annoyances can be eliminated; that careful observation is made as to time and materials consumed in order that suitable standards may be arrived at, against which accomplishment may be measured; that advice and instructions are given in order to assist the various persons interested in attaining the standards set; that suitable records are maintained in order that the management may know exactly what is being accomplished; that those who measure up to the expectations are rewarded in proportion as they assist in converting "waste products" into "by-products."

As will be easily seen, the above is not the usual procedure in the majority of enterprises. The usual course is to engage a manager; to allow him a limited time in which to get acquainted with the conditions and the product, and after that to tell him to go ahead and get results. His time is devoted to securing business; pushing the work through the shops—many times regardless of the cost; running a "diplomacy bureau" for the benefit of the customers; worrying about finances and getting customers to pay their bills; listening to complaints from his men; settling disputes and quarrels, and a thousand and one other things that an executive is called upon to do in the course of seven or eight hours daily. While so busily engaged, in spite of the fact that he may have facts and figures in abundance regarding what has been and is being done (which he uses as best he can when he has a little time), it is easy to appreciate how it is possible, in the absence of a well-organized attempt to convert wastes into cash, for time to be lost, money thrown away, materials scrapped, etc., all because industrial endeavor seems to be conducted on the assumption that the more detail a man can look after in the course of a day, the greater he is as an executive and the more he should be able to accomplish. As a matter of fact there is a limit to the amount of detail a man can handle, but *practically no limit to the supervision that an executive can exercise.*

Supply the executive with proper records and a staff of men who can assist him in locating and eliminating wastes and inefficiencies; make him a supervising agent, not a drudge; furnish him two good strong arms with which to work—one the "analytical force" with which he can study the past and present as a guide to the future—the other the "constructive force with which he can improve and build new structures, and the "By-Products Department" will pay dividends far in excess of the cost involved. Unless this is generally conceded to be the proper scheme of management—and not only conceded but *generally adopted*—we are going to have with us, as a destructive factor, the condition of affairs so clearly pictured in the chart.

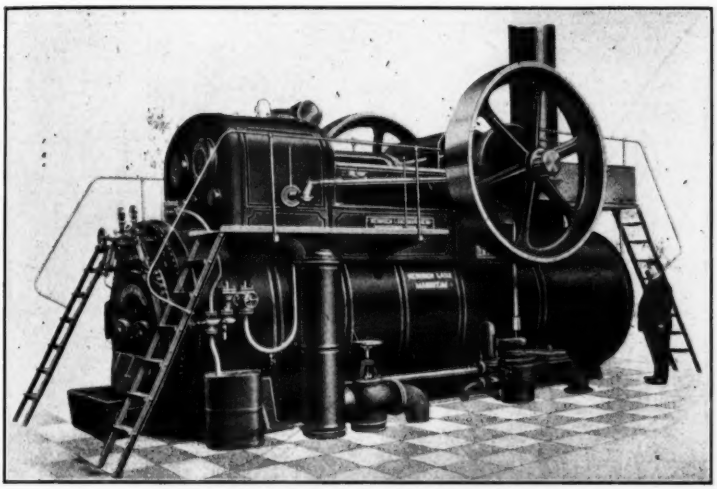
THE LOCOMOBILE OR SUPERHEATED-STEAM UNIT.

By Warren H. Miller.

Mr. Miller's article is the fruit of a recent visit to the Continent for investigation and study of mechanical developments. It is of much possible significance for owners or managers of isolated power plants of moderate size where fuel and water economy is of prime importance.—THE EDITORS.

ONE of the striking things in the development of modern industrial Germany is the growth of the locomobile or superheated-steam unit, and this at a time when no further advances were looked for in the steam engine as a prime mover—except perhaps in the direction of the steam turbine. It is to the credit of the technical training of the German engineers of this generation that today there are over three thousand of these units in operation throughout Europe and Europe's trade dependencies, ranging in size 1,000 horse power down to 35 horse power, realizing an economy of 9.65 pounds of steam per hour per horse power, or 1.2 pounds of coal. Such radical improvements in steam economy in a unit of 100 horse power over the accepted regime of 30 to 60 pounds, as is usual in our plants—that is to say, 5 pounds of coal per horse-power hour on the power-plant coal accounts—are not obtained except by courageous putting into practice of all the things that scientific training shows to be possible in the generation of a horse power of work from the mineral coal.

Our own technical graduates have been taught, and know very well, that the losses in cylinder condensation amount to nearly 30 per cent with saturated steam, most of which can be eliminated by going to superheated steam; that the feed pump can and does waste nearly a fifth of the coal pile in getting water into the boiler; that the radiation from steam pipes, cylinder-walls, and boiler represents a loss of about 5 per cent of the coal burnt; and that, if you reduce the coal, all these losses, including the 20 per cent wasted up the stack, will drop accordingly. Yet, in actual practice, they are well content to design a 100 horse-power isolated station with a boiler room and engine room, steam feed pumps, ordinary low-pressure saturated steam, a high-speed engine of some 30-pounds steam economy, and a boiler which will deliver this steam at about 410

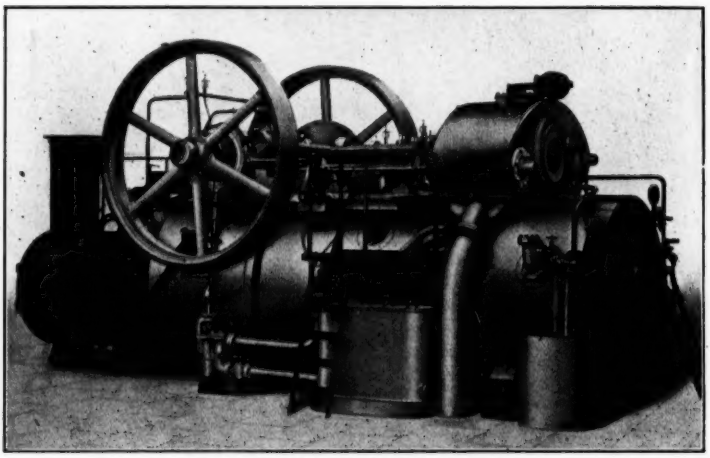


AN 800 HORSE-POWER LANZ LOCOMOBILE.

degrees F. stack temperature. Such a plant is considered a fair example of good steam engineering for small isolated stations—yet it is not the least, by far, among our numerous wastes of national resources.

For, if you study that plant from a purely scientific standpoint, you will at once perceive that, even at the outset, it is far below what is theoretically possible. And when you compare its four or five pounds of steam per hour coal consumption with the German one pound, and realize that its stack losses alone are equal to the whole German coal bill, it is evident that, practically, it is far below what is being done with thousands of German isolated plants of a similar character throughout Europe. At the Brussels World's Fair today the electric light and power for the whole exhibit is being furnished by a 1,000 horse-power Lanz locomobile superheated-steam unit, occupying a floor space of 25 by 35 feet, including the boiler, direct-connected to a dynamo on the boiler, and running in parallel with a 500 horse-power Wolf locomobile of similar design, neither of them using more than 10 pounds of steam per horse-power hour.

If we examine the American plant there are at once a number of obvious criticisms in the light of theory which will be readily granted. There is no superheating—therefore the boiler is too large by at least 50 per cent, because to provide enough steam at a con-



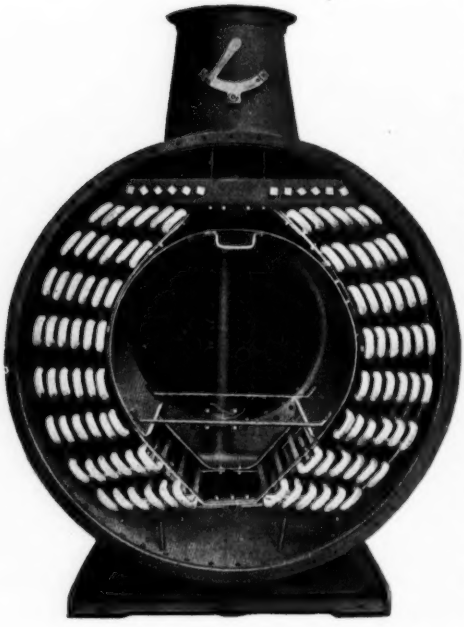
A WOLF LOCOMOBILE, 500 HORSE POWER.

version of 75 per cent to make up in power for the loss of 30 per cent in cylinder condensation the boiler itself has to be that much bigger. Another 10 per cent gets away in using steam at 110 pounds instead of 170, therefore the boiler is again too large by 15 per cent to allow for that; there is a loss of another 10 per cent due to absence of cylinder jacketting and the presence of steam piping, all of which has radiation and therefore wastes coal. Again the boiler is too large because the small duplex feed pumps, at 100 pounds of steam consumption, waste steam to about 15 per cent of the coal pile, whence the boiler is at least 25 per cent too large to provide for that. It is also too large because the waste gases go right up the stack instead of being used in superheating coils; and, being too large for all these causes combined, these waste gases are also far too large, as they represent 20 per cent of the coal, and the boiler must be therefore still 30 per cent larger to take care of *that* loss. Finally the floor-space and the building are too large, because the boiler is from twice to three times too big, and the engine might as well be mounted on the boiler, together with the dynamo, and house them all in one small building. The boiler being twice to three times too big, the radiation from it is also just that much too great, and, finally, the plant will not stay even at those figures, as it will scale, and there is no way to take out the furnace and tubes to clean them. The best that can be done is to soften the scale and send in a man with a compressed-air hammer to do what he can, and send a rattler through the tubes to clean them out.

And yet, if one examines the latest type of German superheated-steam unit, all these criticisms will be met with good working practical dispositions. You note that the key to the situation is the reaction of the economy of steam upon the boiler plant. If you cut down the steam consumption, the size of the boiler falls correspondingly, in the ratio of 1.3 to 1, and with it falls the loss up the stack and radiation and other absolute losses, dependent entirely upon the size of the boiler. If one succeeds in cutting the steam from 30 pounds to 10 pounds, the size of the boiler will be less than one-third and the stack losses alone of the large boiler will be three-fifths of the whole coal consumption of the smaller one.

This gain in steam consumption is worth any amount of careful study to obtain, and obviously the road to it lies in the direction of eliminating every possible loss in the steam *after* it is once made, in making it at the best temperature and pressure and in getting the feed-water into the boiler. The losses in the engine are due to cylinder condensation when wet steam is used; radiation from any and all systems of steam piping; radiation through heads and walls of cylinders; clearance waste; and the inability to use the waste flue gases in any way about the engine. Again, in the boiler, a study of our accepted designs will show that one has considerable freedom in the disposition that can be made of the hot fire gases before releasing them up the stack. The tubes can be made of such a length as to take out all the heat that is at all valuable from the gases, except that which is below 400 degrees and therefore of little value except to heat feed water in an economizer. One will then get the maximum evaporation of saturated steam at, say, 340 degrees or 110 pounds pressure.

But, as the engine will gain 27 per cent in economy if the steam is superheated to 600 degrees F. and re-superheated again between high and the low-pressure cylinder, it seems at once advisable to design the boiler so as to pass the gases out of the tubes at somewhere about 700 degrees, using the rest of the shell to carry superheating coils. As further economy lies in getting as many expansions as is possible in two cylinders, it is also advisable to design the boiler for 170 pounds pressure instead of 110, which is generally carried in small plants. Then, as the temperature of the steam at the end of the high-pressure expansion will be about 230 degrees F., a second set of superheating coils can still be interposed in the path of the gases which will leave the first set at about 400 degrees. By passing this steam through the coils in a contrary direction to the

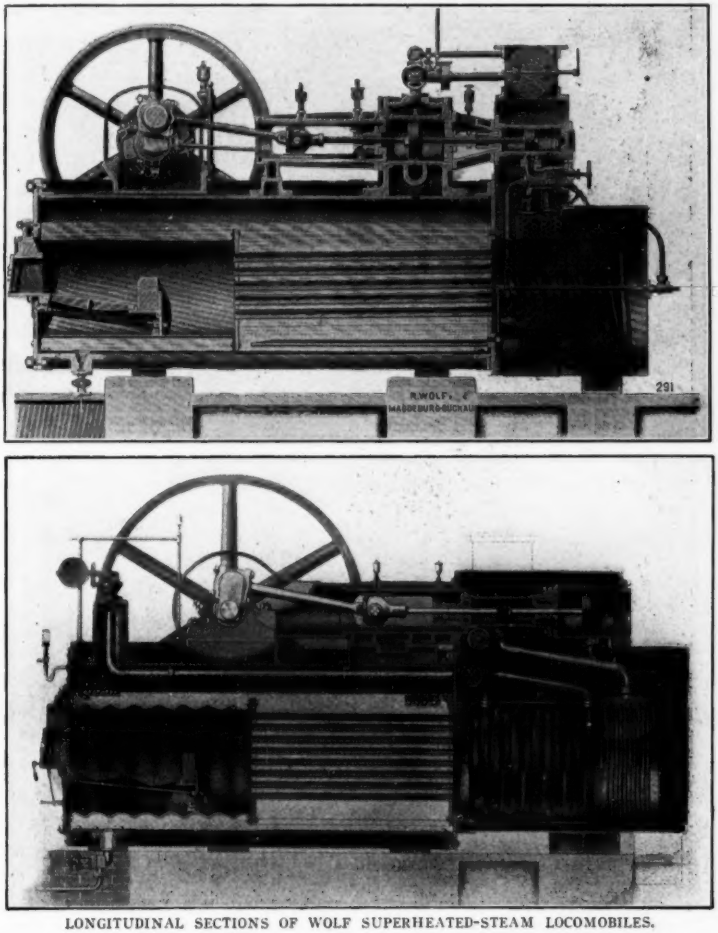


LANZ SUPERHEATED COILS.

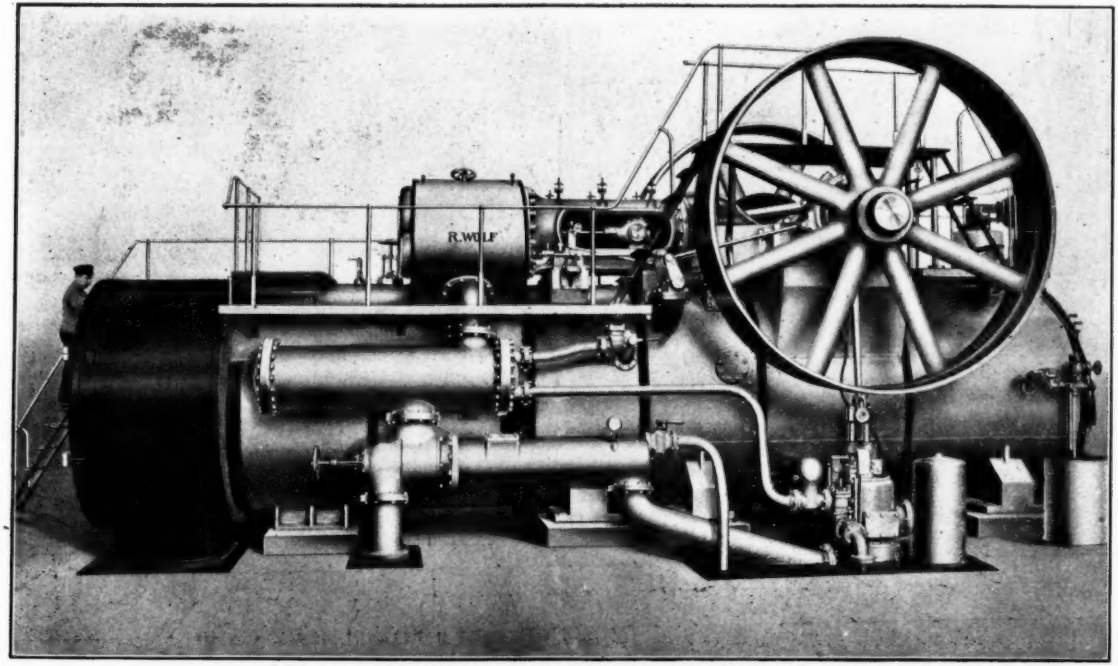
flow of gases, it will arrive at the outlet to the low-pressure cylinder at about 360 degrees, the gases around that part of the coil being 400 degrees. At the stack end of this coil the gases need not be over 350 degrees to give heat to the entering steam at 230 degrees. A still further use of the gases would be to pass them over economizer coils in the stack, but, as the draught gets poor below 350 degrees, this is problematical and must be solved for special cases. These above arrangements have virtually eliminated cylinder-condensation in both high and low, besides which, as superheated steam at 600 degrees occupies a volume of 1.3 in proportion to the same unit weight of saturated steam, there is more absolute work in it, aside from elimination of cylinder-condensation.

To take care of the other losses, such as radiation and boiler feed, the sections of Wolf compound superheated-steam units on page 69 will show at a glance the dispositions. The high-pressure cylinder is mounted in the stack and the low in the steam dome. Both of them are thus jacketted, the low more effectually than the high as it is surrounded by comparatively hotter medium than the steam inside, but the high with stack temperature at 360 degrees has still a hotter medium than most of the expanding steam inside, in addition to taking out waste heat instead of live-steam heat as does the low. Mounting them both on the boiler shell not only makes the unit compact and gives a jacket to each cylinder, but it eliminates the lines of steam mains and engine taps always to be found in the

ordinary small plant. These with their attendant leaks and radiation count no small item in the coal bill. In the locomobile unit all the piping is in the boiler shell except for the short lengths which rise to the cylinders; therefore, not only is radiation eliminated, but the pipes are virtually jacketted with hot flue gases. The large spiral tubes in the smoke box are the high-pressure superheater, and the small multiple tubes beyond the return in the smoke-box take care



LONGITUDINAL SECTIONS OF WOLF SUPERHEATED-STEAM LOCOMOBILES.



A WOLF SUPERHEATED-STEAM COMPOUND LOCOMOBILE UNIT.

of the exhaust of the high-pressure cylinder on its way to the low-pressure.

This type of engine secures the most advanced use of all the heat in the coal, to date, and with its economy of 8.65 pounds of steam per hour per horse power, or 1.04 pounds of coal, it crowds the gas-engine pretty closely. It is made by R. Wolf of Magdeburg-Buckau in sizes from 35 to 70 horse power.

In the larger sizes the design has up to the present taken the form of cross-compound engines with both cylinders mounted in the steam dome, that is cast in one piece with a cast-iron steam dome. Those made by the Wolf company run up to 500 horse power, and by the Lanz company of Mannheim up to 1,000 horse power. In order to get room on the boiler for large engines it is almost imperative to build them cross-compound, thus sacrificing a fraction of economy due to placing the horse-power cylinder in the smoke-box, but all the engines of this type do from 9 to 11 pounds of steam per brake horse-power hour or 1.30 pounds of coal.

As might be expected, these advantages in the use of superheated steam were not obtained without a wrestle with the heat problems involved. No ordinary saturated-steam engine will run well on highly superheated steam, as the oiling of the distributing valve is somewhat difficult and the packing of valve rods and piston rods must also be done with metallic packing. In Germany they use a good deal of Schwalbe metallic packing for these engines and the Wolf company use light iron piston-valves in all their engines without having had any undue oil consumption or lubrication trouble reported against them.

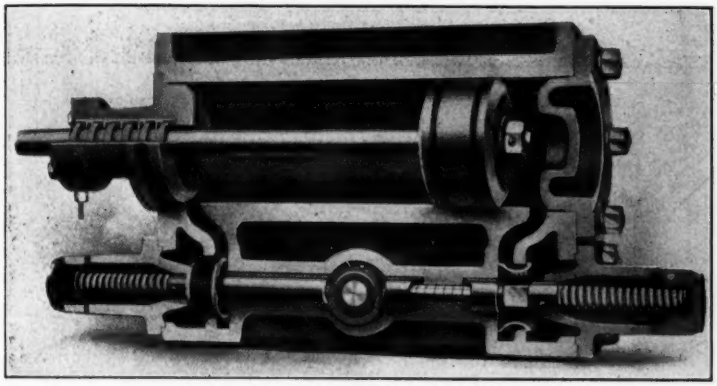
But Heinrch Lanz of Mannheim has introduced the lift-valve system of steam distribution on his superheated-steam units, thus eliminating all lubrication, and has also adopted the scraped labyrinthine packing for valve rods, and return-steam packing on the piston rods. These arrangements have all become quite common on the various French, Belgian, and German large slow-speed steam engines using superheated steam and are mainly the outgrowth of deficiencies in ordinary steam-engine valves and packings when used with superheated steam. The lift valve is virtually the Stevens balanced ferry-boat engine valve, revived for use with high-heat steam for which it is excellently adapted. In the form of the "Lentz" system of valve-gear illustrated on page 73, it has been adopted by a number of the largest European engine builders, such as Krupp in Germany, Bollinckx in Belgium, and Tosi in Italy. It eliminates

the dash-pot troubles experienced with the Corliss valve design; has a constant port opening at all loads; has no friction, and therefore requires no lubrication, so that the latter can be introduced by way of the piston-rod packing; and, being balanced, has but very little mechanical resistance. Its stem is thus made very small, and labyrinthine rings are turned on it, and the rod ground into the bore of the stuffing box. Practically no steam whatever then escapes around this rod, and it does not wear or require repacking as the travel is very small, being only 1-15 of the travel of a piston valve to give the same steam distribution. The labyrinthine packing of the piston rod utilizes the tendency of the exhaust vacuum to draw out condensed steam in the shape of water and oil emulsion from the rings of the labyrinth. There are a set of cast-iron piston rings, fitting lightly on the rod, and the chamber of each ring is filled with lubricating oil under pressure and condensed steam water which soon fills all this space. Helped by the oil pressure and the vacuum during half the travel of the rod, the steam of each stroke returns as water during the exhaust without ever penetrating much beyond the third cast-iron ring.

Aside from these details there is little that is mechanically needful to arrange when using superheated steam. It is not advisable to use brass or copper piping as both weaken considerably at temperatures above 500 degrees. The total expansions from cold engine in the frame are taken up with suitable adjustments of the clearance. The engine frames themselves are of the "open" type, oiled with cups and wipers instead of splash-oiling. Going at 200 to 250 revolutions per minute they give long and efficient service, and the angular variation is as little as any of the heavily totally-enclosed splash-oiled engines of this speed. The tachometer on the 1,000 horse-power locomobile at the Brussels Exposition shows a very steady angular speed, well within the requirements for good parallel operation of alternates on 60-cycle current.

To conclude with the use of steam in a locomobile the following cycle is followed:—The steam enters the engine at 170 pounds pressure and 625 degrees F. superheat; it expands down to 234 degrees in the high-pressure cylinder; is again superheated to 361 degrees and then expands down to 90 degrees in the low-pressure cylinder whence it rejects into the condenser, which is usually of the jet type and mounted on the unit.

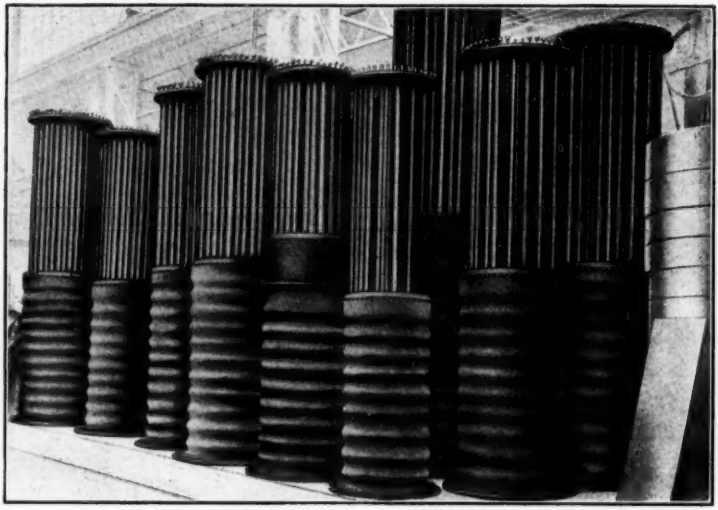
As regards the important matter of mechanical accessories, the first thing to examine is the boiler feed. In a small 100-kilowatt



THE LENTZ SYSTEM OF VALVE GEAR.

plant this is usually furnished by two small duplex pumps, one of which is either running all the time slowly, or else standing idle dripping steam water and run fast at periodic intervals. In either case it must deliver about 5,000 pounds of water per hour into the boiler and will itself consume steam to the amount of 100 pounds of steam per horse-power hour. The actual horse power it will expend will amount to 4 if continuously running to feed 5,000 pounds into the boiler at 170 pounds. This will then be 400 pounds of water consumed by the pump, not counting drip losses. As the main engine uses 3,500 pounds of steam, the feed pump uses 1-8 of the total coal pile, or, on the basis of 1,000 pounds for the total steam consumption for a superheated steam-unit of 100 horse power, it would use up nearly half of the total coal. Wherefore the Germans invariably have this feed pump mechanically-driven by an eccentric and sheave on the main engine shaft, with an injector as a standby. The same thing is done and for the same reason with the air and condenser pump, in a jet condenser, are of course combined in one. But when the unit is driving a dynamo, and electric power is available both from the dynamo and from the city reserve, the Lanz company add a motor-driven condenser pump, which has the advantage of being able to start ahead of the main engine and thus avoid the steam escape attendant upon starting with dry condenser.

Up to last year all locomobiles were used to drive dynamos by belts off the flywheels, but, in the most recent engines, the waste and annoyance of this drive have been eliminated by mounting the dynamo also on the boiler shell, using its rotor as one of the main



FURNACES AND TUBES FOR SUPERHEATED-STEAM LOCOMOBILES.

flywheels. This has turned out entirely feasible in practice, and constitutes a great saving in floor space and friction.

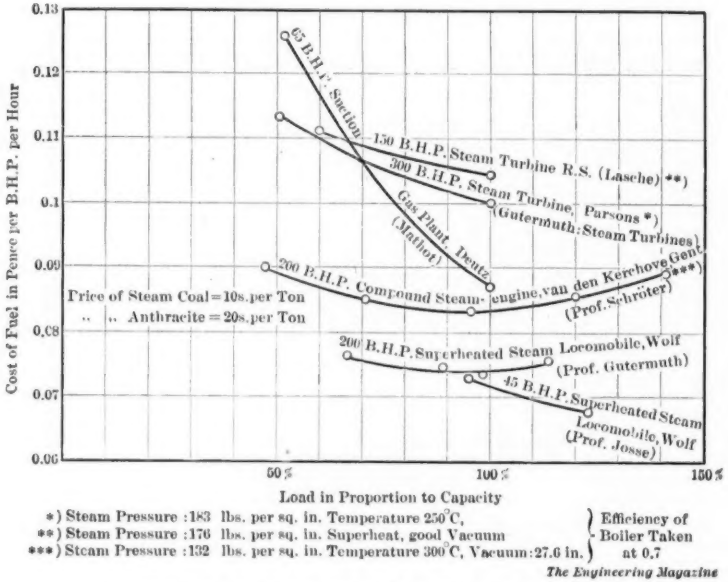
Another mentionable accessory is the very complete system of automatic stokers and low-heat-grade fuel feeders studied out for all sizes of locomobiles. As might be expected the grate is surprisingly small. For a 250 horse-power unit, instead of an 8 by 7-foot grate as is usual with our 250 horse-power boilers, the grate is not more than 4 by 3 feet for good coals. Having this small requirement to work from, it has been easy to design large grates for exceedingly low-value fuels, without getting into special outside furnaces or other structural troubles. All are internally fired in standard marine corrugated furnaces, and the grades of low-value fuels burnt cover wood, shavings, dross lignite, bagasse, corn husks, earthy coal-dust, coffee-husks, sawdust, and straw. It thus gives the locomobile a wide adaptability for isolated stations, so that it is not surprising to find them in the cane-brakes of Cuba, the plantations of Portuguese East Africa, or the pampas of Argentina. Naturally they follow the European trade lines. One of the largest of these over-sea installations is the 2,400-kilowatt central electric plant at Concepcion, Chile, comprising three 800 horse-power locomobiles, or *mi-fixes* as the French call them, put in by the French branch of the Wolf company.

To clean the furnace and tubes the forward tube sheet is bolted to the inside of the head with stud-bolts and cement, and the entire rear head is bolted to the flange on the shell. One can thus take the boiler apart and pull out the corrugated furnace and tubes in one piece, making it easy to clean thoroughly and also to get at the inside of the boiler shell. Our "conservatism" would doubtless land heavily on this sensible scheme, in the shape of getting adequate boiler insurance, but, there it is, used universally throughout Europe, and quite as safe as the bolted heads of a large steam cylinder. The superheater coils can be blown out in place by suitable hand-holes in the smoke box, and, by taking out the return-gas shell, all the coils can be reached for hand cleaning.

The heating of feed water is obtained by a tubular feed-water heater, mounted on the boiler shell and taking the exhaust steam from the low-pressure cylinder immediately after exhaust on its way to the jet condenser. If the water is of good quality it is taken from the overflow of the jet condenser by the feed pump and forced through the feed-water heater on its way to the boiler. A feed temperature of about 170 degrees F. is thus obtained.

The engine governor in all makes of locomobiles is of the flywheel type, advancing or retarding the throw of the eccentric which operates the piston or lift valves. These latter are actuated by a cam containing a large circle of maximum lift; by advancing or retarding the throw of the eccentric, the time in which this circle is in contact with the valve-stem is varied, thus giving a constant opening of the lift-valve which is variable only in the amount of time that it remains open. Having a very light friction, a combination of flywheel and spring, reacting against themselves to control the opening of the centrifugal weights which shift the eccentric, can be used, thus giving immediate and sensitive governing.

A final word as to buildings. The furnace being small and usually automatic, and the boiler having moving machinery mounted on it, it is easy and advisable to keep the entire equipment clean, so that instead of the dusty and ashy boiler-room so common in our own plants, the locomobile units generally look like a new pin, with all bright-work polished and carpet runways in the engine-room and on the platforms. With a downdraft smoke flue leading to the chimney outside, a complete electric generating station can be put up that will be clean and stay so, and that can be housed in a single small building of some simple and ornamental architectural design that will be


Cost of Fuel in Pence per B.H.P. per Hour
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
50 %
100 %
150 %
Load in Proportion to Capacity
65 B.H.P. Suction
150 B.H.P. Steam Turbine R.S. (Lasche) **)
300 B.H.P. Steam Turbine, Parsons *)
(Gutermuth: Steam Turbines)
Gas Plant, Deutz
(Mathot)
200 B.H.P. Compound Steam-engine, van den Kerchove Gent
(Prof. Schröter) ***)
Price of Steam Coal = 10s. per Ton
" " Anthracite = 20s. per Ton
200 B.H.P. Superheated Steam Locomobile, Wolf
(Prof. Gutermuth)
45 B.H.P. Superheated Steam Locomobile, Wolf
(Prof. Josse)
*) Steam Pressure: 183 lbs. per sq. in. Temperature 250°C,
**) Steam Pressure: 176 lbs. per sq. in. Superheat, good Vacuum
***) Steam Pressure: 132 lbs. per sq. in. Temperature 300°C, Vacuum: 27.6 in.
Efficiency of Boiler Taken at 0,7
The Engineering Magazine

COMPARATIVE EFFICIENCY TESTS OF STEAM AND GAS UNITS.

a pride to the operatives and an incentive to keep it the best-run plant in the neighborhood.

To sum up for the remarkable economy of the superheated-steam unit:—By reducing the steam consumption from 30 pounds to 10 pounds the boiler size drops to one-third. By thus reducing the absolute stack loss and eliminating the steam feed-pump, the necessary capacity of the boiler is still further reduced; so that to produce the same energy in mechanical work, the coal actually expended is only one-fourth of what is used in an ordinary steam plant.

THE TWELVE PRINCIPLES OF EFFICIENCY.

By Harrington Emerson.

V. THE THIRD PRINCIPLE: COMPETENT COUNSEL.

Mr. Emerson's current series began in our June issue. The introductory article was a brilliant demonstration, from historic examples, of the power of certain principles of efficiency. His second paper showed the unsuitability of the ordinary organization for the introduction of these efficiency principles, and indicated the nature of the changes necessary to permit their application. In our August number he reached the "Twelve Principles" themselves, and took up the first—"Clearly Defined Ideals," following this in September with the "Second Principle—Common Sense." The wide applicability of the Principles to diagnosis or betterment of efficiency conditions in all sorts of industrial situations is suggested by the collateral papers following Mr. Emerson's article this month.—THE EDITORS.

WHEN I was a boy, hobnobbing with British boys in various parts of Europe, we relied on the manly art of self-defense, and I was expected to hold my own, by my two fists, backed up by my own courage. We loathed the *savate* dexterity of the French boy, the knife play of the Italian boy, the stone-wrapped-in-handkerchief sling of the German boy, for we considered such methods of defense and offense not according to the rules of the game. Nevertheless a well directed kick in the stomach from a French boy stopped very effectually my onward rush, and a slash from a pocket knife in the hands of an hysterical Italian boy, a leather belt loaded with a heavy brass buckle and murderously swung by a German boy, and other similar experiences taught me that bare fists, a stout heart, and supreme contempt both of the personality and ethics of an antagonist, were not sufficient to insure even an honorable truce, much less victory; so I compromised by carrying a club cane which I had feloniously poached from a king's preserve, the irregularity of acquirement adding a sentimental value to the weapon.

The early American manufacturer, generally of British blood, relied also on his own skill and knowledge. He was a practical man, and if a blacksmith, iron was iron and his own skill mastered the material; if a cabinet maker, wood was wood, not a veneered and inlaid concoction, and his own skill mastered the materials. These early leaders scorned the thought that they needed lawyer, purchasing agent, accountant, bouncer, private detective, doctor, chemist, or standard-practice engineer to help them run their shops and business.

They believed in themselves as much as their contemporary in the presidential chair, Andrew Jackson, believed in himself. It has been only by slow and reluctant steps that great American executives, heads of large corporations, have acquiesced in the innovation of specially qualified advisors. The change has come too fast, for there are men—Andrew Carnegie, James J. Hill, John D. Rockefeller—who have not only witnessed the change from the simple to the complex, but who have themselves been the mightiest human element in bringing about the change. Human industrial giants, who know as to the whole scope so much more about a business than any late arrival of a specialist, may well be excused for impatience and scepticism too often fully justified.

A great president of a transcontinental railroad was troubled by the flooding and washing away of his line on the slope of a foot hill. His engineers recommended relocation of the line at a cost of $800,000. The old eagle called for an Irish roadmaster and contractor; out they sped in the president's special, and for a whole day they tramped the situation.

Following their conference and decisions, wing ditches were dug so as to divert the surface water around the hill and away from the road bed, the remedy costing $800 and proving a complete success.

Another railroad president asked his engineering department to estimate the cost of grading a road in Texas. The estimate based on experience elsewhere was $800 a mile. The veteran president, a frontiersman from birth, called in a bright division superintendent and asked him if he could grade the extension for $450 a mile. Committed to the superintendent it actually cost $435. The water chemist to the same president strongly advocated a treating plant at a certain well. The president demurred because it was not at that point that water gave trouble. The chemist insisted that the water showed more grains of incrusting matter than at any other point. The president secured from another official a table showing the number of locomotives taking water at each of the tanks and found, as he expected, that very few watered at the bad tank, very many at the good tank, whose water, only containing half the grains of solid matter, deposited ten times as much in the boilers because twenty times as much was used.

Many of the older executives must today not only fulfil their own duties but in addition see that the inexperienced one-sided specialists do not cause more trouble than they cure. Nevertheless, best practice in any line depends today on such a vast range of experience and knowledge that no one man, even in a very limited field, can master it

all. No modern captain has a pilot's license for all harbors, and the wiser the captain, the larger the vessel he commands, the more willing and anxious he is to depend on local knowledge, even if the expert be an Arab, a Malay, a Kanaka, a Maori, or an Eskimo.

The trouble with the water-purifying chemist was that he was too inexperienced, too limited to pass on the whole subject. His opinion was valuable and sufficient as to the grains of solid in each water and at that he ought to have stopped.

Competent counsel cannot come from one man. All around us are the laws of the universe, here and there partly read and codified, but with many great and partially traversed regions. Counsel, direct or indirect, is wanted from each man who knows the most, so that we may not be floundering along on last week's, last month's, last year's, last decade's, or last century's knowledge, but use special knowledge, today the possession of the few, but destined to become world practice.

High-speed steel was made known to the world by Messrs. Taylor and White in 1900. In 1903 one of the great western railroad shops was still without it; in 1910 another railroad shop in the Eastern States, was discovered taking 18 hours to turn a pair of locomotive drivers, 3 hours being ample time on the type of lathe used. There are facts about high-speed steel, the dimple of durability, for instance, as yet known only to the few.

In striving for industrial efficiency of operation, we have made pleas for a different type of organization—the defensive, constructive organization instead of the offensive, destructive organization; we have made a plea for definite high ideals instead of indefinite low ideals; we have made a plea for supernal common sense instead of near common sense; but no radical change in either point of view or practice is needed to extend the use of competent counsel from legal, accounting, purchasing, engineering, and other departments to an efficiency department.

The legal counselor of a great corporation is often a vice-president, the purchasing agent is often a vice-president, the chief engineer is often a vice-president, but the efficiency counselor is often a subordinate far down the line attached more by accident than design to some special department.

The legal counselor extends his warning, helping, guiding hand to every other department. "You may not do this because it is illegal; there is reasonable doubt as to another action; there is no doubt as to another plan." He does not pass on finances, records, engineering, or efficiency questions. The financial counselor stands against irregular

expeditures however much needed; the purchasing agent buys what is requisitioned in the best and most advantageous market.

In the vanishing era of elementary achievement, efficiency mattered not, but legality did; therefore long ago lawyers were consulted. Efficiency did not matter in the building of the pyramids, but engineering did; and from that time to this the engineer has been supreme in his own department. If it were not for the lawyer passing on charters, titles, agreements, there could be no railroad; if it were not for the financiers raising sums far beyond the power of even the richest individual there could be no railroad; if it were not for the engineer who designs the machinery that produces steel, who designs cars and rails, bridges, turntables, locomotives, there would be no railroad; if it were not for the traffic manager the rails would rust, the cars stand empty; were it not for the operating executives, there would be collisions and disasters.

But the railroads and industrial plants almost without exception are operating without efficiency counsel, efficiency problems of momentous import being decided off-hand, by intuition. Is it to be concluded that efficiency is of minor importance?

At the present moment the business of the country is disturbed, shippers are arrayed against railroads and railroads against shippers; railroad employees are being urged to act as a voting unit against any one who favors legislative interference with railroad operation. Because it is not competently advised from the efficiency standpoint, the Interstate Commerce Commission prescribes monstrously difficult, even impossible standards, brushing aside the accumulated wisdom and experience of the Master Car Builders' Association. Because they are not competently advised by efficiency counsel, shippers fight any rate increase, unable to point out wherein it is unreasonable, the fact being that many present rates are too low and others too high. Because they are not competently advised as to the economies in operation and maintenance that would flow from efficiency, the railroads overlook the great gain within their grasp while they pursue the much smaller gain from greater rates they may not succeed in securing.

The total annual salary and labor bill of the railroads of the United States in 1908 was $1,035,437,528. It is probably 15 per cent higher for 1910. There is an impressive appearance of accuracy in these figures from which we are pained to miss the odd cents, but an examination of the sub-divisions shows that the average equivalent obtained is not quite 80 per cent, that a preventable waste occurred of over $200,000,000.

In contemplating this enormous waste, the accuracy of expenditure statement loses its impressiveness, and side by side with these valuable and accurate figures of the expert accountant, we would like to see other figures from the efficiency counselor—other figures of far greater practical import.

The other annual bills for operating expenses were, in 1908, $653,780,115, of which about $500,000,000 was for material. Is the efficiency of material used more than 60 per cent? Wherever it has been carefully and scientifically checked, in railroad operation, efficiency has scarcely reached 40 per cent.

The cost of all railroads and equipment is reported for 1909 at $14,514,822,308. Interest at 6 per cent and average depreciation of 4 per cent (which is low) gives an hourly charge of $165,694 for these two items. An increased use of 4 per cent would amount to a gain of this amount each day, or over $50,000,000 a year. As the net earnings of the railroads in 1909, including sinking funds, were only $1,078,132,735, the railroads were about $400,000,000 short of earning 6 per cent plus depreciation, but sympathy is not as great as it would be if it were not so evident that wastes were annually occurring, a very large part of them preventable and aggregating a sum larger than net earnings.

What the railroads have not yet realized is that natural expenses are progressing geometrically and revenues are only increasing arithmetically. For a time heavier locomotives, larger cars, lessened grades, longer trains, counteracted the geometrical danger, and it is doubtful whether highest efficiency will provide all the remedy needed, whether competent counsel of the highest order will not become imperative. The primary question, however, is not whether inefficiency costs the railroads $100,000,000 or $1,000,000,000 a year; but the question is why either loss should occur, and whether it is not sufficient to warrant competent counsel.

The legal counselor does not, cannot know all the laws and proper legal formalities in every State, and he therefore employs junior and often senior counsel. Similarly a counselor as to efficiency would not pretend to be an expert as to all efficiency, but it would be his duty to be in touch both as to men and scientific reports with all that was latest and best and make it all available for his employer whether individual or corporation.

If the corporation were large it would be the duty of the efficiency counselor to install and develop an efficiency organization, extending from top to bottom even as the accounting department extends from top to bottom. Each minor official would have his own staff of effi-

ciency experts working directly for him, but also even as the time-keeper to a superintendent is subject to the comptroller, so also would each efficiency expert be subject to the direction of the efficiency officer above him.

The chief efficiency counselor would initially advise as to type of organization; he would ascertain what the ideals were and strive for their realization; he would represent supernal common sense; but it is chiefly as to the standardizing of the other operative principles that his organizing ability would be applied. In most operating plants both discipline and fair deal are defective, records are neither reliable, immediate nor adequate, despatching is so elementary as scarcely to be beyond the stage of putting into the shop an order for work, there are few, if any, scientifically made work schedules, there are no standard-practice instructions, no standardized conditions, no standardized operations and efficiency rewards are defective.

Competent counsel must permeate every efficient organization, and if competent counsel cannot be carried into operation, it is because the organization is defective, because some staff is lacking, and the staff that usually still awaits creation is the efficiency staff.

In coal mining in the United States the question is not whether 5 per cent or 3 per cent of the miners are killed each year, it is not the question whether we kill more or less than England kills, but the question is why a smaller per cent obtains in the more dangerous and difficult Belgian mines.

A cholera epidemic is now raging in Europe. It is particularly bad in Russia, and is making headway in Italy. Several times in the last few years Germany has been infected, but each time competent counsel has prescribed procedure which has stamped out the disease, even measures advised and enforced by competent counsel have stamped out yellow fever on the Isthmus of Panama.

In chemistry more advance has been made in ten years than in all the previous time; metallurgy, fifteen years ago was in its infancy. A generation ago a hospital was a charnel house and a doctor a peripatetic disseminator of contagion and infection. A generation ago sailing vessels were the rule and ocean steamers the exception, and farming had advanced only one step beyond the Egyptian or Assyrian methods. All this gigantic betterment has come because there was competent counsel, so competent counsel well deserves to be one of the Twelve Principles of Efficiency, and nowhere else is competent counsel more needed than in the application of the eleven other principles.

Practically there is close analogy between other competent counsel and competent efficiency counsel.

SMOKE PREVENTION AND THE EFFICIENCY OF FIREMEN. A CONCRETE INSTANCE.

By J. A. Switzer.

Professor Switzer's short paper, contributed independently, is presented in close association with Mr. Emerson's fifth article as an illustration of practical efficiency following application of the principles of "Competent Counsel," or expert advice, and standard-practice instructions.—THE EDITORS.

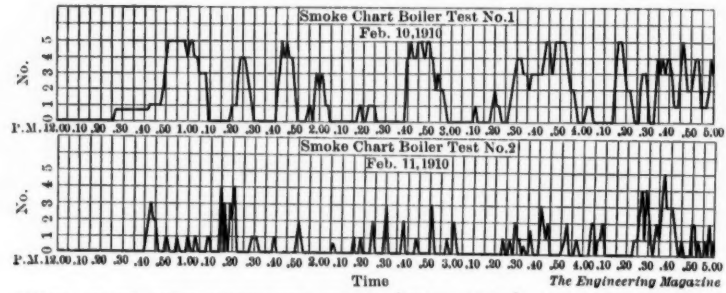
THE superintendent of one of the largest cotton mills in the Southern States, a man who takes great pride in the equipment of his million-dollar plant, recently installed in his power house No. 2 a battery of four Scotch marine boilers equipped with Hawley down-draft furnaces. In selecting this type of furnace he had been influenced not a little by the claim of the makers that it lent itself particularly well to the combustion of low grades of soft coal without smoke.

Notwithstanding a visit of a week's duration from an expert fireman, sent by the makers to instruct the resident fireman, the plant was a prodigious smoker. This condition being naturally very obnoxious to the superintendent, and the statement having been made by the Department of Mechanical Engineering of the University of Tennessee that, in the judgment of its professors, an abatement of the smoke was not only possible but would prove a measure of economy as well, a request was sent to the University to make such tests as were needful to substantiate their claim.

Accordingly two tests on successive days were made by the Department of Experimental Engineering; the observers employed on the tests were students in the senior class in mechanical engineering in the University, and they were under the constant surveillance of the writer.

The equipment of the plant was as follows: four 200 horse-power Continental boilers of the Morrison Scotch marine type, served with Hawley down-draft furnaces; a Gleaner feed-water heater; a Green fuel economizer. Draft was natural, being obtained by a chimney 152 feet in height. The power required of the plant being between 600 and 700 horse power, but three boilers were in service.

Throughout the first test the fireman handled his furnaces in the manner to which he was accustomed, having been told simply that the conduct of the test was not to interfere with the regular service. His



SMOKE CHART WITH INEFFICIENT FIRING (UPPER SCALE) AND WITH EFFICIENT FIRING (LOWER SCALE).

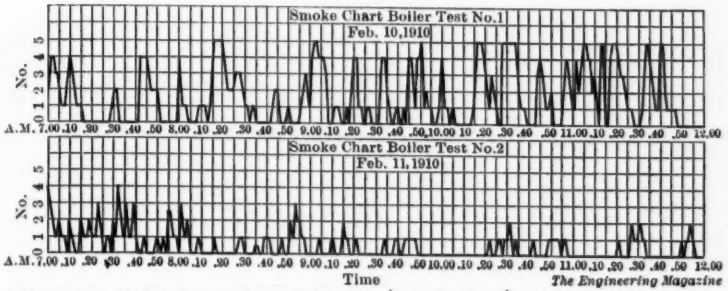
method was to fire at comparatively long intervals, to fire large quantities of coal at a time, and frequently to "understoke," that is, to fire green coal upon the under grates. He explained to the writer that "owing to the heavy demand made upon the boilers, steam could not be held without resort to under-stoking." Throughout the test smoke observations were made by continuous comparison of the smoke issuing from the stack with the Ringelmann chart. The trial was conducted in accordance with the code of the American Society of Mechanical Engineers, by the alternative method.

The day of the second trial chanced to be stormy, and was so dark that the lighting load was carried nearly all day, thus increasing the load on the boilers. The load during the first day was 647 boiler horse power; during the second, 690.

For the second trial a different fireman was employed, and his handling of the fires was directed and closely watched by myself. Coal was fired frequently and in small quantities; no green coal was fired upon the under grates, and the slice bar was used with caution in order not to shake down from the upper grates any coal from which the volatile matter had not been distilled.

Due precaution was taken to avoid prejudice on the part of the smoke observers in favor of the second day's record; and as no watch was kept of the graphical log, no notion of the relative boiler performances was had during the progress of the test. Except, indeed, that it was evident even to the coal heavers that less coal was being used the second day, we were in the dark as to the showing we should make.

A very casual comparison of the two smoke charts here shown will make evident the lessening in smoke production that was accomplished; combustion the second day was so nearly smokeless that the



SMOKE CHART WITH INEFFICIENT FIRING (UPPER SCALE) AND WITH EFFICIENT FIRING (LOWER SCALE).

requirements of the most drastic smoke ordinance existing anywhere would have been met. Even more striking however is the comparison of the two boiler performances. To set these forth clearly the principal data secured are here shown in parallel columns:

	First trial.	Second trial.
Duration of trial, hours	11	11
Steam gauge, pounds	136	133.2
Draft gauge, inches of water	0.447	0.419
Temperature flue gas (before passing economizer) degrees	480	448
Temperature flue gas (after passing economizer) degrees	353	336
Heat value of coal, B. t. u.	13,234	13,017
Total coal consumed, pounds	27,015	25,418
Total refuse, per cent	12.7	11.4
Per cent CO_2 in flue gas	7.34	7.50
Total Weight apparent evaporation, pounds	234,586	249,934
Equivalent evaporation per pound of fuel, from and at 212 degrees	9.22	10.9
Equivalent evaporation per pound combustible, from and at 212 degrees	10.54	12.2
Boiler horse power (34½ pounds equivalent evaporation per hour)	647	690
Efficiency of boiler and grate, per cent	67.5	81.0

The saving in fuel is thus seen to be approximately 25 per cent, and figured on a basis of 650 horse power for 312 working days per year and counting the cost of coal at $1.50 per ton, this represents an annual cash saving of $1,544.

Could a better argument for the employment of really intelligent men in boiler rooms be found? How often one finds power plants wherein the engine room gives asylum to a high-grade man, while apparently it is assumed that the ability to heave coal—and plenty of it—is a sufficient endowment for the boiler-room attendant!

REDUCING THE COSTS OF ENGINE BUILDING BY EFFICIENCY METHODS.

By Wm. O. Webber.

IN the course of practical experience some years ago, with efficiency methods applied to the manufacture of steam engines, I obtained and recorded certain results which are epitomized in the schedules and comment presented on the following pages. For the sake of brevity the tables are confined to two typical examples, each representing lots consisting of twenty engines. In the first of these tables it is apparent that the average reduction in total cost was over 9 per cent. The second and third tables show that the reduced cost of manufacture was secured by a lower expenditure per hour and in spite of the use of actually more hours put upon the work. The last table reduces the construction time to a percentage basis showing that over 11 per cent more time was put upon the second lot of engines than upon the first.

This additional time represented additional care, finish, and quality. The prices paid for all machine labor were identically the same in both cases. The lowered total cost per hour consumed was due largely to better facilities for doing the work (such as improved jigs and other devices) and to better and more immediate and reliable records, which made the costs attainable within a few hours of the completion of the job. The extra time put upon the later lots represented more really serviceable work; for example, the lower slides were made adjustable as well as the upper slides, and a number of features of this class were introduced, making the product a better engine in every way. The tabulated results are as follows:

Size.			Per Cent.	
8 by 12	$537.57	$485.45	90.4	
9 " 12	617.05	561.42	91.0	
10 " 12	655.71	592.25	90.4	
10 " 15	684.84	610.62	89.1	9.1 gain.
11 " 15	761.25	695.85	91.2	
12 " 16	889.00	807.40	90.9	
13 " 16	906.00	826.70	91.2	
14 " 16	1070.00	999.78	93.0	
			8)7272	

90.9 per cent average.

COMPARATIVE COSTS IN CENTS PER HOUR.

Size.	Hours.				
8 by 12.....	2,405	divided	by	$537.57	21.2
9 " 12.....	2,813	"	"	617.05	20.9
10 " 12.....	3,090	"	"	655.71	21.2
10 " 15.....	3,365.5	"	"	684.84	20.2
11 " 15.....	3,674	"	"	761.25	20.8
12 " 16.....	4,250	"	"	889.00	20.9
13 " 16.....	4,530	"	"	906.00	20.
14 " 16.....	5,050	"	"	1070.00	20.8

cents per hour first engines.

20.75 average per hour first engines.

Size.	Hours.				
8 by 12.....	2,776	divided	by	$485.45	17.5
9 " 12.....	3,185	"	"	561.82	17.6
10 " 12.....	3,426	"	"	592.25	17.3
10 " 15.....	3,570	"	"	610.62	17.1
11 " 15.....	4,021	"	"	695.85	17.4
12 " 16.....	4,707	"	"	807.40	17.1
13 " 16.....	4,728	"	"	826.70	17.5
14 " 16.....	5,510	"	"	999.78	17.2

cents per hour later engines.

17.34 average per hour later engines

RELATIVE TIME PUT UPON THE WORK.

Size.	Hours.	Hours.	Per Cent.
8 by 12.....	2,405	2,776	15
9 " 12.....	2,813	3,182.5	13.4
10 " 12.....	3,000	3,426.5	11.
10 " 15.....	3,365.5	3,570.5	06.
11 " 15.....	3,674	4,021.5	09.5
12 " 16.....	4,250	4,500	06.
13 " 16.....	4,530	4,728.5	04.5
14 " 16.....	5,050	5,350	06.

per cent more time used in construction of later engines.

11.4 average do.

The methods followed, as identified and classified by Harrington Emerson's "Twelve Principles of Efficiency," may be briefly described:

FACILITIES.—It is very evident that it was a waste of time to put the bed of an engine upon the planer simply for the sake of planing the lower guides, especially as a jig had to be used centering one end by the journals, and the other end by a trunnion put through the stuffing-box hole and kept absolutely square and level with the journal jig. Furthermore, there was no opportunity of taking up any wear which might eventually occur in the lower slide, and as the engine ran over and generally in a forward direction, a large part of the wear would occur on this lower slide. It was therefore determined to avoid putting the bed on the planer at all by casting a recess where the guide

should go, planing the lower guide separately (as the upper one was planed), then putting it into position on the erecting floor, leveling it up with the jig, and babbiting it in position at the same time that the journal boxes were babbitted and the jig originally put in position. This transferred the work on the lower slide more to the erecting floor, and avoided planing the bed at all, but of course put more work on the smaller planer on which the slides were planed. Another change was made by which brasses were milled on the milling machine instead of being planed on a planer, a jig being provided which cut all the brasses in a string and milled the two opposite sides with end millers at the same time. The brasses were then one-quarter turned in unison and the end millers did the same work on the other two sides.

A still further change was the milling of steam-chest covers on a jig which milled both sides of the cover at the same time with end mills in a similar manner.

A still further change was made in supplying cylinders to the erecting floor with the heads ground in, the studs all in place, and the jacket fitted on by a gang of men cheaper than the ordinary erecting men, who kept ahead of the erecting gang and had at least fifty cylinders of different sizes fitted up.

BETTER AND MORE IMMEDIATE AND RELIABLE RECORDS.—In this case the records were immediately gone over, and if any particular work was excessive, for instance the planer work on the 10 by 12 engines or the shaper work on the 12 by 16 engines in the list given last August*, an inquiry was at once instituted to find out why this planer work was higher than either of the next smaller or next larger engines, and the trouble was traced to its source. This was sometimes found to be an error in keeping the records; sometimes the men, in putting in their time slips (which they did every night), charged the job up to the wrong set of engines; sometimes, getting broken up on their job, they had to replace jigs unnecessarily; sometimes the trouble came from defects caused by the foundry, such as a new moulder put on any given job keeping his sand too wet, causing all the castings made by this new moulder at first to be too hard, thus taking up a great deal more time in the machine shop.

It is obvious in the case of the shaper time that the jobs were charged to one lot of engines; in the planer time, where the additional cost is only about 10 per cent of the average, the reason is more difficult to find, with the exception that the job might have been broken up. It requires a good deal of moral courage on the part of a superintendent, when the office is clamoring for a certain size of en-

* The ENGINEERING MAGAZINE, August, 1910, page 730. "Costs of Machine-Tool Operations in Steam-Engine Manufacturing."

gine, to prevent such additional cost, but I have invariably found that it was expensive to break up an operation or a job in order to expedite the completion of any particular lot or size of engines.

It is obvious even to the uninitiated that if all of the machine-tool operators were working on the same lot of engines at the same time, they were much less liable to error in making out their time slips each night than they would be if two different lots of the same size engines were in the machine tools at the same time. For instance, it would be easy enough to keep the parts for a lot of 10 by 12 engines distinct from the parts of a lot of 12 by 16 engines, but if two different lots of 10 by 12 engines were in the machine tools at the same time, it was often difficult to keep, say, lot 122 separate from lot 128.

PREMIUM WORK.—As a specific instance of premium work at the Blank Car Wheel Works, we paid $1.80 for 12 blocks fitted into tyres per day; this was at the rate of 15 cents per block. I offered the man $2 for 13 blocks per day, which is at the rate of 15.4 per block; he jumped at the proposal, and as soon as he became expert at that, I offered him $2.50 per day for 15 blocks per day, which is 16 2/3 cents per block. This he thought was very liberal, but we had increased our output 25 per cent, and although this was an increase of 39 per cent in wages, yet it had the effect of increasing the output of the factory 25 per cent at no extra general cost.

DISCIPLINE.—I remember on first going to the Blank Iron Works the men were allowed to smoke when they were working, at any time of the day, and when a man was sent on an errand from one department of the factory to another he always improved the opportunity of getting a smoke. I put a stop to this by requiring the men to stay in their own departments, and if a message or request had to be sent from one department to another it was sent through the foreman by the usual requisition blank; the letter-carrier boy who went round once every half-hour delivering mail and messages. Smoking was forbidden during working hours, excepting that a man was allowed to finish his pipe in the morning directly after the whistle blew at 7 o'clock; he was then prohibited from smoking again until the noon hour, when if he smoked he was required to do so in the blacksmith shop, but given permission to finish out his pipe when the whistle blew at 12.30. There were no printed or written rules about this thing, or in fact about anything, but the unwritten laws of the shop were thoroughly understood and strictly enforced.

Another instance of discipline was forbidding the men to congregate at the grindstone ostensibly to sharpen their tools, but also for the purpose of gossiping. This we stopped by taking out all the grind-

stones in the factory, requiring every tool worker to go to the tool room and get a sharp well dressed tool; this he was allowed to keen up on a water grinder, several of which were installed at short distances around the shop. At first this created a great deal of opposition, as no workman wants another to sharpen a tool for him. As soon, however, as the work was largely piece work, and the operators had begun to realize the benefit of certain standard shop methods and forms, they readily accepted the tools as they were furnished from the tool room, and the water grinder was used only for such actual "keening of the edge" as was absolutely necessary to expedite the work. Piece work also prevented any idling or gossiping at the water grinder, as nobody wanted to idle his time when it meant dollars and cents to him.

FAIR DEAL.—From an inner and personal knowledge of the different processes and methods of doing work, I am sure it is very essential to evolve properly a system of piece and premium work. This also means to evolve properly a system which shall be fair to employer and employee. It seems to me that it is absolutely necessary for the man directly in charge of the men, the superintendent, or whatever may be his title, to be absolutely fair to either party, and so much so that it is recognized by all of the men that he is absolutely fair—the minute that this attitude is changed and the feeling is engendered that he is trying to beat them down to the lowest notch possible in all of their efforts, the usefulness and influence of the superintendent is largely gone.

Probably the best work that I have ever read to properly equip myself for such a position is Charles Read's novel "Put Yourself in His Place" which has to deal with the cutlery makers in England something like one hundred years ago. Probably no book ever written made so strong an impression upon me as the one quoted, which I read some forty years ago when at the machinist trade myself. So strong was the impression made at that time that I resolved if I ever got into a position of authority I would endeavor to be absolutely fair with myself, the employer, and the employee. It is absolutely necessary to have such an attitude in order to be in the slightest manner successful in the handling of a large body of workmen. They certainly are no fools, and it is a great mistake ever to assume that they will be for any length of time. There probably have been no wiser words ever written than those of the immotral Lincoln:

"You can fool some of the people all the time and you can fool all of the people some of the time, but you cannot fool all of the people all of the time."

EDITORIAL COMMENT

The Problem of the Terminal.

THE opening of the eastern link of the Pennsylvania tunnels, from the New York Terminal to the Long Island connections, has attracted attention anew to this remarkable undertaking and its significance from various points of view. Financially, it is gigantic; technically, a subject of deeply interesting study and observation, past and future; economically, a perplexity—a plunge of magnificent proportions and doubtful expediency. The magnificence, however, is for the present dazzling, while the wisdom or unwisdom remains to be proved.

So far as the Pennsylvania Railroad alone is concerned, some apparent facts are that the serious and burdensome factor of expense of the terminal division will be hugely increased. The costly structures in New York, with all their appurtenances, will not displace nor materially relieve the maintenance of the Jersey City Station, the ferries, and the subordinate terminals on the Manhattan side of the rivers. So far as passenger movement is diverted from Cortlandt, Desbrosses, or 23d street, to the new Terminal, however, the effects on city conditions will be distressing rather than otherwise. They will be an impairment of the present fairly good distribution of travel among centers well equipped with branching local transportation lines, and delivery of more or less of this travel, thus diverted, at a point at present conspicuously deficient in distribution facilities, and able to secure them only with the almost inevitable result of discharging its stream through what is already one of the most congested foci of Greater New York—Herald Square.

Practical demonstration during the first few days of use seems to suggest that travel will be reluctant to concentrate at the new Terminal, preferring to continue the use of facilities which, though older and slower in actual time of transit between termini, yet reach delivery points nearer to the passengers' objective. The problem of congestion may not become acute simply because travel will not throng to the Terminal so long as the ferries remain open. This, however, while palliative of anticipated evils, would not be a happy vindication of the Terminal's existence. And so far as the Terminal does attract any dense condensation of passenger movement toward Herald Square, it will be the negation of the influence so much needed in solution of the problems of traffic in a great city. The need, as lately defined by one of our leading contributers, is "to secure distribution, to scatter foci, to relieve congestion." The Terminal contracts distribution, creates foci, causes congestion.

"Tonnage Mania."

THE great terminal seems to be a product of the tonnage mania so searchingly criticised by Harrington Emerson in our August issue. The American imagination falls readily captive to the idea of size. Huge locomotive units, huge train units, huge steamship units—why not huge terminal units? The connection with economic results—with unit efficiency in performing a unit of work—is almost or quite overlooked. Indeed, American railroad magnates have seldom been great economists, even seldomer great psychologists. Had they been the former, railroad finances would now be in far sounder condition, far less dependent on the uncertainties of an effort to increase carrying charges. Had they been the latter, they would not have alienated popular sympathy by petty autocracy toward passengers, exasperating indifference toward individual shippers, double dealing with legislatures and with the public.

Even now, as one of the ablest financial reviews has lately pointed out, their capacity for wrong-headed action is showing itself by lack of frankness in meeting the Interstate Commerce Commission's investigation of rates, and by lack of wisdom in needlessly curtailing maintenance expenditures for the sake of producing an artificial deepening of the current industrial depression. The policy deceives nobody, while it offends many. It is pointedly illuminated by Judge Gary's statement just given out "that if the railroads were buying up to their necessities, the mills would be crowded." Of foolish legislation there is enough and to spare, and the railroads have suffered much from it; but childish conduct on their part will not effect a cure, nor improve their position.

Industrial Engineering.

IT is not always easy to recognize the character or tendency of a process of evolution going on immediately under our eyes, and for this reason, perhaps, the technical world was slow to realize and to acknowledge that the requirements of modern manufacturing were calling into existence a new department of engineering, specialized, and distinct from any of the branches of the profession generally recognized up to say about ten years ago. It was slow to realize that organized manufacturing was inherently and necessarily an engineering proposition which should be committed to and managed by engineers, and it is only within a comparatively short time that industrial engineering has gained anything like an acknowledged standing.

The creation of this new sphere of technically trained activity shows many points of similarity to developments that have been observed elsewhere in the past—that is, it is an instance of applied science following the creation or the evolution of a new art or occupation for mankind. Such an instance might be found in the case of navigation. When travel oversea became more than an incident of exploration or adventure —when commerce required the ministry of staunch and safe vehicles moving with reasonable regularity and certainty—the science of navigation was developed to conserve and promote the art of seamanship. It has drawn upon older and purer science—upon astronomy, upon meteorology, upon hydrography, but out of its more elementary components it has fused a distinctive body of science of its own.

Again, with the introduction and use of the steam engine and of machinery, mechanical engineering arose to the dignity of a characteristic applied science, drawing upon chemistry, upon physics, upon mechanics (all older and purer sciences) and yet out of these elementary components forming its own characteristic body. An analogy to this same process seems to appear in the case of industrial engineering, but the movement is so comparatively young that the distinctive character of this science (as already said) has been but impartially and sometimes grudgingly acknowledged. It is often supposed, or assumed, that industrial engineering is merely a province or an application of mechanical engineering. Industrial engineering does, indeed, draw upon mechanical engineering in something the same way that mechanical engineering drew upon physics, or navigation drew upon astronomy for a part of its foundations; but yet the province of industrial engineering is distinctively different from that in which the mechanical engineer has long been established.

Indeed, the industrial engineer may have in his organization staff many mechanical engineers superintending special departments—design or construction, or the power-plant, for instance—while his own duty is to co-ordinate all these factors and many more for the one great central purpose of efficient and economical production. He is concerned not only with the direction of the great sources of power in nature, but with the direction of these forces as exerted by machinery working upon materials, and operated by men. It is the inclusion of the economic and the human elements especially that differentiates industrial engineering from the older branches of the profession.

REVIEW OF THE ENGINEERING PRESS.
"THE WORLD IS ITS FIELD"

MACHINE TOOLS FOR HIGH-SPEED STEEL.

A DISCUSSION OF THE DESIGN OF MACHINE TOOLS TO TAKE THE HIGHEST POSSIBLE ADVANTAGE OF THE CUTTING POWER OF HIGH-SPEED STEEL.

H. I. Brackenbury—Institution of Mechanical Engineers.

WE have referred before in these columns, in connection with Prof. Rautenstrauch's discussion of lathe-headstock characteristics, to the manner in which the development of high-speed steel has reacted on machine-tool design. This subject is more fully developed in the following review of H. I. Brackenbury's paper "High-speed tools and machines to fit them," read at the recent joint meeting in Birmingham of the Institution of Mechanical Engineers and the American Society of Mechanical Engineers. Much that is valuable in Mr. Brackenbury's paper, his graphical and numerical data of machine-tool performance, we are obliged to omit. The abstract following, however, gives in brief all the essential parts of his discussion.

As a preliminary to the consideration of the design of machines suited to the use of high-speed tools, Mr. Brackenbury briefly reviews the characteristics of the tools themselves. There are three classes of high-speed tool steel: class A, for cutting mild and medium steel; class B, for cutting hard steel (such as tires, etc.); and class C, for cutting very hard steel and for use in cases where a sharp and lasting cutting edge is required, especially useful in cases where deep cuts with fine feeds are used. More power is required to remove a thin, wide chip than a chip of double the thickness and half the width. The additional power required, however, is less the sharper the tool. Tools with blunt cutting angles require more power than tools with sharp cutting angles to remove the same amount of material; but there is the objection to sharp cutting angles that the edge is likely to break.

Within certain limits, the total power used for a given cut, including the power absorbed by friction in the machines, increases at a smaller ratio than the increase in cutting speed. It is a very difficult matter to lay down rules for cutting speeds. Results of tests of high-speed steel under ideal conditions are interesting and useful as indicating the directions in which improvements can be made in both the design and the use of machine tools, but they are not of much use as an indication of what is actually performed in the ordinary workshop. There are so many variables in the actual conditions (Taylor's twelve variable elements do not exhaust the list) that, without a careful study of each particular case, the determination of the best cutting speed is extremely difficult.

"Careful experiments have shown that the sharper the cutting angle, the less power is required to remove a given amount of material, the feed and depth of cut remaining constant. On the other hand, the sharper the cutting angle, the more likely is the cutting edge to crumble or break, and the smaller is the body of steel to conduct away the heat generated by cutting. The importance of

working to standard angles is obvious, and the fewer the standards the better, so long as the loss in cutting efficiency is not greater than the gain in grinding and forging tools to a small number of standards." The standards chosen must depend on the variety of work and material and the quality of machines in the shop. Slavish adherence to standards is to be deprecated when many variables are involved; it should be the duty of the manager or foreman to experiment with tools of various cutting angles when a suitable run of work is available. Further, advantage should be taken of improvements in the quality of tool steels. High-speed steel has improved in the past few years and will probably improve in the future, and with these improvements it is found that the cutting edge remains sharp for a longer time and that the cutting angles may be made more acute.

On turret lathes the highest class of high-speed steel is now largely used, and tools with a very sharp cutting angle are employed. Mr. Brackenbury gives data of the performance of high-speed steel in turrent lathes and other machines. Perhaps the most striking instance of its value is in the case of twist drills. Given sufficient power, a high-speed drill does three times the amount of work and requires grinding less frequently than the temper-steel drills. Generally, however, full advantage is not taken of the cutting powers of high-speed steel, although in all cases where it has been introduced valuable economy has been effected by the increased speeds and the increased length of time tools run without the need of grinding.

Not enough attention has been given to the savings accompanying the use of high-speed steel. Where full use is made of modern machinery, the production, in so far as roughing-out goes, is three times what it was under the old conditions. Further, although the power required to drive machines capable of making full use of high-speed steel is very large, the power absorbed for each pound of metal removed is less for high-speed than for low-speed machines. The full saving possible can be made only by setting aside certain machines for roughing and for roughing only. In introducing high-speed steel, it is not necessary to replace all or even many of the old machines, which have quite enough power to carry the finishing cuts at good speed. It is not desirable to use the same class of materials or of labor for roughing as for finishing. When it is not possible to buy new machines, much may be done by making a judicious selection of the heaviest of existing machines and increasing their belt speeds so that high speeds may be run with the back gear in. In some instances the cones have been removed and replaced by wide pulleys, speed changes being provided for by means of sliding gears.

Turning now to Mr. Brackenbury's discussion of machines suited to the use of high-speed steel, it is pointed out that an idea of the saving in cutting time may be gained from a comparison of the powers allowed for machines designed before and after the introduction of high-speed steel. Engineers have grasped the fact that the power which may be usefully employed depends upon the stiffness of the work and not on the height of centres in the case of lathes or the length of stroke, etc., in the case of other machines. The increase in power, of which Mr. Brackenbury gives a number of illustrations, must be accounted for by a desire for increased depths of cut and feeds as well as increased speeds.

There seems to be no finality as to the amount of power which can be applied to a machine. In the desire for rapid production, however, it is important not to overlook the consideration of the cost of power and value of material cut to waste in cases where the work could be made nearer to the size in a more economical way. While it is impossible to lay down any law regarding the limiting point of the weight and power of machines, on account of the number of variables, three principal governing factors may be recognized: (1) the length of time the machine will be used for heavy cutting; (2) the length of time for light cutting; and (3) the length of time at rest. During (1) the machine is used efficiently; during (2) more is

being paid for power and capital charges than if a lighter machine were used; during (3) more is paid for charges than in the case of a lighter machine. These considerations evidently point to the importance of using heavy machines for roughing only in every possible case.

The stepped cone is rapidly becoming obsolete, except in the case of small machines. The disadvantages of this method of changing speed are the trouble and danger of throwing a heavy high-speed belt from one cone to another, and the variation in power from the different belt speeds. Speed changes are provided for by sliding gears, in the case of medium-sized machines, and variable-speed motors in the case of larger machines. Motors on the three-wire direct-current system give a large and excellent range of speed. It is well to notice, however, that at certain speeds at light cuts, the efficiency of motor and machine may be far from good. To illustrate what losses of power may take place in a lathe which is apparently perfectly satisfactory, Mr. Brackenbury gives curves showing the electrical horse power at various speeds for a large lathe, the feed and depth of cut remaining constant. The curves show a drop in efficiency at the change from low to high voltage, and an extraordinary gain in efficiency when a change is made from the high voltage and high gear ratio to the low voltage and low gear ratio, the result being that practically the same amount of power has to be paid for at cutting speeds of 18 and 33 feet per minute. Heavy lathes which are required to do both light and heavy turning should have the gear ratio arranged so that the full range of speed may be obtained from either voltage, and builders of such heavy machines should give the total efficiency of lathe and motor at various speeds and loads. It is true that the expenditure of power is in most cases only a small portion of the total expenditure, but when the total expenditure is large, the small portion becomes quite large enough to trouble about.

The gears which are always in mesh should have helical teeth to ensure quiet and smooth running and to prevent chatter. The pinions should be hardened and, of course, all wheels should be made either of forged steel or of steel castings. It is of great importance to cut the teeth of gear wheels to a considerable degree of accuracy. Worm and work wheels should never be used unless hardened. The introduction of high-speed steel has meant the replacing of many work and worm-wheel drives by spur-gear drives. Finally, all feed arrangements must be made amply strong, as in certain cases the side pressure is equal to the vertical pressure on the tool.

A review of recent progress in machine tool design, illustrated with drawings and photographs of typical machines, concludes Mr. Brackenbury's paper. Dealing first with roughing lathes, very heavy machines are now built for taking heavy cuts. The beds are made very wide to give ample support and bearing surface for the saddle, and the spindles are made of what appears to be excessive strength, but it is most important to have ample bearing surface and an absolutely rigid spindle to prevent chatter. A general rule is to make the diameter of the front bearing half the height of the centre. There should always be a hole through the spindle, to accommodate the bolt for drawing up expandings chucks or for supporting the end of a boring bar. The tailstocks should be very massive and clamped to the bed by two bolts in the case of the smaller sizes, and three bolts for larger sizes; the diameter of the barrel should be one-third the height of centres. One maker provides an arrangement of expanding cones with a belt driving by its bevelled edges, and by this means any speed between the highest and the lowest can be obtained. When applied to a cutting-off machines, arrangements are made so that the speed automatically increases as the diameter being cut diminishes.

Turret lathes have been greatly strengthened. One machine has reduced a bar from 2¼ inches to 1 inch diameter at a traverse of 11⅜ inches per minute with an expenditure of 20.7 horse power, when using class C steel. The ordinary steadies were found quite useless at this

high duty, and a roller steady has been introduced with excellent results. Such a machine fitted with a roller steady averages an output at least 33 per cent. greater than the output of the older machines designed for the use of ordinary high-speed steel, and at least 100 per cent. more than that of machines built before the advent of high-speed steel, so that the extra cost of the modern machines is small compared with the saving.

Mr. Brackenbury describes in detail two slotting machines adapted to the use of high-speed steel. Concerning jib drilling machines he says that great attention is now being paid to stiffening to prevent deflection of the saddle. One maker provides a double-girder jib with a space between the two girders for the saddle, which is supported by the girders on each side of the spindle, so that there is no twisting movement around the horizontal axis of the jib. Change-speed gear boxes or variable-speed motors are generally provided, allowing from 12 to 15 horse power for the larger sizes. These machines can drill inch holes at a rate of 5 inches per minute, and 100 inch holes per minute through inch plates is ordinary practice. Really fast drilling cannot be done on old machines, as the spring and twist of the jibs cause the drills to break and in many cases the feeding and withdrawing arrangements are very unsatisfactory. Still, high-speed drills can be used to considerable advantage in some of the best of the older machines, although running the drill at high speed and fine feed entails considerable loss of power.

The power allowed for milling machines has been greatly increased within the last few years, but it is very doubtful if milling machines should be used, except in special cases, for heavy roughing work, as the power required to remove material with a milling cutter is very large as compared with tools of the lathe type, about double per pound of material removed.

"A great advance has been made in the cutting speed of planing machines, and naturally with the increase in cutting speed came a desire for a quicker return stroke. Heavy planing machines now have a return-stroke speed of 90 feet per minute and lighter machines are made with a return stroke up to 180 feet per minute, the shock at the reverse being absorbed by recoil springs. Various devices are now made which can be fitted to pre-high-speed planing machines by means of which the above results may be obtained at a moderate expenditure of money, and the results are most satisfactory. It seems a pity that more use has not been made of the arrangement fitted to the planing machines designed by Sir Joseph Whitworth for cutting on both strokes; certainly for roughing out this is very economical."

MODERN METHODS OF MOSQUITO EXTERMINATION.

A DESCRIPTION OF THE WORK IN PROGRESS IN THE SALT MARSHES OF NEW JERSEY.

John B. Smith—Engineering News.

SINCE the discovery that mosquitoes are responsible for the dissemination of yellow fever, malaria and other diseases, mosquito extermination has been added to the problems of sanitary engineering, and in some localities the problem is of no less importance than that of water purification. Even where the disease-carrying species do not exist, mosquitoes sometimes constitute a pest of such magnitude as to warrant the application of engineering methods to the removal of the conditions under which they breed. A campaign of this sort has been begun in the salt marshes of New Jersey and $350,000 has been appropriated for the work by the State. Prof. John B. Smith, under whose direction the work is being carried out, has given in *Engineering News* for September 1 an interesting account of the methods employed.

When Prof. Smith began the systematic study of the New Jersey problem, "it was found that instead of a few, there were many species of mosquitoes:

instead of great uniformity, there was a great diversity in life history; instead of being home-bodies, some forms were great travelers, and that a locality might be almost unbearably afflicted without breeding a single specimen. One fact remained to us, and that is a vitally important one. Mosquitoes develop only in water; it may be salt or fresh, clean or foul, in motion or stagnant; but there must be water in which the larval life can be passed. There need not necessarily be water when the eggs are laid, for many species lay them in mud or in damp places that are only seasonably or occasionally covered, and such eggs may lie dormant for two, three or perhaps more years; but development never takes place until water comes.

"Another vitally important fact brought out by my investigation was, that two species bred abundantly only on salt marshes along our coast, and that both these species were migrants, flying as far inland as 40 miles under favorable conditions. Futhermore, that there might be from six to eight broods annually on these marshes, out of water ranging from pure salt tide to rain fresh. In New Jersey alone there are over 290,000 acres of salt marsh, and over half of that is or until recently has been, mosquito breeding ground. My work demonstrated that over 90 per cent. of the pestiferous specimens in the state were of the salt marsh species, and the importance of dealing with that area became at once manifest.

"Early mosquito campaigns consisted chiefly of getting rid of local stagnant pools and covering large swampy areas with oil—effective enough within its range, but out of the question in work covering a state. When the entomologist had worked out all the factors dealing with the life cycle and habits of the species, it became a problem for the engineer.

"Theoretically, the matter is simple enough. An ordinary salt marsh is almost level; is porous, so that water runs out easily; and outlets to tide-water are usually within convenient reach. Experiment and observation proved that large ditches were not needed; but that, to be effective, ditches must be deep, straight and with even sides and bottom. The final outcome was a trench 10 inches wide and 30 inches deep, wherever the character of the ground would stand it. At first shovels and spades were used in the digging work; but the results were not good and the cost was great. Then a modified hay knife or bog saw was used to cut the sides of the ditches, and the intervening sods were taken out with hooks and spades. This was much better and cheaper; but not sufficiently rapid. Two of the contractors invented spades, especially adapted to this type of ditching, by means of which a sod 10 inches wide, 30 inches deep and 6 to 8 inches long, was taken out at each plunge. With such spades a gang of two or three men could run out from 600 to 800 feet of perfect ditching in an eight-hour day.

"Finally, from a model patented many years ago, a power ditcher was produced, with which a crew of five men can dig 4,000 feet of ditch in an eight-hour day, and the cost was reduced to about 2 cents per running foot. This machine runs on planks over the marsh, and the cutting knife is at the back, so that the body is always ahead of the ditch. The essential point is a plunging knife forming three sides of an oblong, the fourth or open side behind. This knife has the sides 12 inches long, the front 10 inches wide, is firmly attached to a sliding frame which, in turn, is suspended from the end of a long, powerful lever beam. This beam is slotted and in this slot runs a pin attached to one of the spokes of a heavy driving wheel. As this wheel revolves, actuated by a 12-horse power gasoline engine, the lever beam is alternately depressed and lifted, forcing the knife deep into the marsh and lifting it out again. At the low point of the depression a swinging knife comes into play, cuts under the sod at the depth of 30 inches and remains to serve as a bottom to the knife until it is lifted clear of the ditch. The sod is hooked off by an attendant who draws it to one side and is kept fully employed when the machine is smoothly at work. With each plunge of the knife the machine moves

forward 1 foot, so that sods of even size, 10 by 12 by 30 inches, are taken out and laid in an even row alongside the ditch.

"Up to the present time some 25,192 acres of salt marsh have been drained in New Jersey, by 3,464,974 feet of ditches, and the work has demonstrated its effectiveness. This drainage is only sufficient to remove surface water fast enough to prevent mosquito breeding; but it results, incidentally, in a great improvement in the character of the marsh and the amount of hay produced on it.

"The work now being carried on in New Jersey is along a carefully prepared plan; but at present, so far as the state is concerned, covers only the salt-marsh or migrating forms. The local breeders are considered as coming under the jurisdiction of the municipality where they are found and only suggestions and advice are given. The entire marsh area of the state has been carefully looked over, the indicated drainage scheme has been roughly laid down on tracings from the State Geological Survey Maps. The cost of carrying out the scheme was put at $350,000.

"Not all marsh areas are as easily dealt with. Some of them are in pockets among the sand hills, and the turf is too shallow to hold a ditch. In such cases filling must be resorted to where the areas are not too large. This filling has also developed as the result of experience, and solid work is no longer attempted. The low area is first covered with layers of shrubs, seaweed, hay or whatever is most readily available, and then enough sand is shoveled over it all to keep the loose filling in place. The loose projecting twigs and branches serve excellently to hold blowing sand during high winds and storms, and in a year or two a solid fill naturally results.

"In larger confined areas where there is no outlet, yet another method—that of draining to a center—is adopted. Areas of that sort are usually very low, and at the lowest point of all, water stands for days and weeks, especially early in the season. Out of such areas come the early spring broods and usually the latest of the season as well. It is easy enough to locate the low point during the summer, and there we dig a pool from 6 to 10 or 15 feet square, and about 3 feet deep. In the center of this pool a large barrel or hogshead is sunk. As the barrel is always below the tide line, its contents never dry out. Ditches, as needed, are drawn to this pool, using the natual drainage lines so far as possible, and then the place is stocked with 'killies,' the little species of *Fundulus* which run in every creek throughout the marshes. It is surprising how quickly such areas dry out by this method, even after long-continued rains. When the area is flooded, the fish run everywhere and quickly dispose of any wrigglers that appear. As the water goes down the fish and wrigglers retreat with it, and the more concentrated the larvae, the easier do they become prey to the fish. In a droughty period the fish retreat to the central pool and finally to the barrel, which never dries out because it is below tideline. Indeed, in most of the barrels thus far sunk, there is a distinct tidal change of level varying from 6 to 12 inches, and it may be that considerable water actually gets away through the sand from these pools.

"Another type of permanent improvement which eliminates mosquito-breeding marshes, is sand filling by dredges. Hundreds of acres have been treated in that way by improvement companies and promoters, and miles of territory have been made available for settlement.

"Inland conditions vary more greatly and require a greater variety of treatment. About cities and towns, the dirty and stagnant water problem is best referred to local boards of health, who should deal with it as other nuisances are dealt with. The matter is not entirely simple, since it also involves the city catch-basins as breeding places; and here the city engineer can aid materially in the selection of a type of basin that offers least chance for breeding.

"In woodland areas there are always depressions that are water-filled in early spring, and develops one brood of mosquitoes that hang about until mid-summer. Where such areas are to be dealt with, drainage and filling must be done,

and here again a great deal of filling can be very cheaply done, because no solid fill is necessary. Grass, leaves, branches, anything that forms a bed that prevents free water from standing above, will answer the purpose.

"Deep cold swamps are not dangerous as breeders and need no treatment; neither do open-water areas exposed to wind currents. But overgrown shallow edges of open swamp areas or ponds are dangerous and must be dealt with. Sometimes merely killing out the vegetation along the edges will answer, as thereby fish will be given a chance to get at any insects that may appear. At others it may be necessary to deepen an infested area or fill it. No two problems are entirely alike here, and each must be dealt with according to its special needs."

THE FIELD ASSAY OF WATER.

THE USES AND LIMITATIONS OF FIELD METHODS OF WATER TESTING AS COMPARED WITH LABORATORY METHODS.

R. B. Dole—Engineering News.

DURING the last six field seasons more than 3,000 field assays of natural waters, by the methods suggested by Marshall O. Leighton in 1905, have been made by United States Geological Survey parties. The purpose of Leighton's methods have been widely misunderstood. They are not intended to displace laboratory analyses, nor is it claimed for them that they yield results comparable in accuracy or availability with laboratory methods. Leighton's purpose was to place at the disposal of engineers, chemists, geologists, and scientific explorers in general a means of making in the field partial approximate assays of natural waters by the use of solid reagents and apparatus that can be carried in a knapsack. The experience of the Geological Survey has been that in careful and trained hands Leighton's tests, granted a proper appreciation of their limitations, on the part of the user, are of great practical utility in industrial and geological reconnaissance.

The limitations of the field assay are defined by R. B. Dole of the Survey in *Engineering News* for August 11. Fifty-two waters, ranging in total solids from 25 to 5,200 parts per million and representing the common kinds of surface and underground waters in the United States, have been analyzed in the laboratory and tested by field methods. The results of the two methods Mr. Dole presents in parallel columns. Without reproducing the exact numerical data we may summarize briefly Mr. Dole's discussion of the results and his conclusions as to the practical utility of the field assay.

Dealing first with the determination of bicarbonates, "the estimates of bicarbonates in the laboratory were made by titrating measured amounts of water with N/50 sulphuric acid in the presence of methyl orange indicator. The field tests were done in reverse manner; a proper number of tablets of sodium acid sulphate were dissolved in a small amount of the water to be assayed, methyl orange was added and then water until an alkaline endpoint was reached, after which the volume of liquid was measured. One of the tablets used in the tests is equivalent to 2.49 milligrams HCO_3. The parts per million of bicarbonates (HCO_3) in a water can readily be computed from the amount of water, the number of tablets, and the value of one tablet in milligrams of HCO_3."

The average error of the field tests in the 44 cases which Mr. Dole considers significant was 6.2 parts per million, or 3.5 per cent., with waters containing 100 to 350 parts per million of bicarbonates; the errors ranged from 0 to 9 per cent. and were equally divided between positive and negative. It is clearly established that the error is not a constant one, due to error in the value of the tablets or to the change in shade of the indicator, but that it is variable and is caused probably by error in measuring the water. The average error of 3.5 per cent. corresponds to 2.1 cubic centi-

metres, not an unreasonable variation considering the facilities for measurement. "Most waters do not contain normal carbonates (CO_3) and a qualitative test suffices to show their absence; but if it is necessary to make the quantitative determination it may be performed on a separate portion of water in the presence of phenolphthalein and the bicarbonate figure may be corrected in accordance with the result."

Chorides were determined in the laboratory, when less than 100 parts per million, by titrating 100 to 250 cubic centimetres of the water concentrated to 25 cubic centimetres with a solution of silver nitrate, 1 cubic centimetre of which was equivalent to 0.5 milligram of chlorine; and when more than 100 parts per million, by precipitating and weighing the chlorides as silver chloride. In the field tests, 50 cubic centimetres of water were titrated with tablets and quarter tablets of silver nitrate. "For low chlorides tablets equivalent to about 1 milligram of chlorine were employed, and as one-quarter tablet in 50 cubic centimetres of water is equivalent to 5 parts per million of chlorine, the field results may vary from the true values 5 parts, a difference which may be equivalent to an error of 100 per cent. Such discrepancies offer little practical disadvantage, however, for it is as useful in geological or industrial reconnaissance to know that a water contains less than 9 parts of chlorine as to know that it contains, for instance, exactly 5.4 parts." The accuracy of low-chlorides estimates is increased by using 100 instead of 50 cubic centimetres of water wherever practicable, but no particular advantage has been gained in using weaker tablets instead of quartering the tablets of ordinary strength.

The average error of 22 tests of waters containing more than 50 parts of chlorides was 6 parts, or 3.2 per cent., and the errors are almost equally divided between positive and negative. "If the chromate indicator is added at the beginning of the titration of waters exceeding 400 or 500 parts of chlorides, an excess of silver nitrate choride formed during solution of the tablets becomes stained with silver chromate that is decomposed with difficulty. It is better, therefore, to make first a rough estimate of the chlorides and then to repeat the determination, the indicator in the latter test being added near the end of the titration. All the tablets except one or two may be ground with a small quantity of water, then the remainder of the measured portion of the water may be put in, and the titration completed in the usual manner. This modification involves little extra work and increases the accuracy of the results."

Sulphates were determined in the laboratory by the usual gravimetric method in 250 or 500 cubic centimetres of water. In the field tests about 1 gram of coarsely pulverized barium chloride was added to about 100 cubic centimetres of water made very slightly acid to methyl orange by the addition of hydrochloric acid (1—1). The mixture was then shaken for ten minutes or until the precipitant was entirely dissolved and the turbidity of the liquid was then measured by means of the regular form of candle turbidimeter in a shaded corner of the laboratory in daylight. The solution was kept constantly and thoroughly agitated while three readings were made; a standardization table gives the amount of sulphates corresponding to the average of the three readings. The success of the field method depends upon the addition of a minimum of acid and the constant agitation of the liquid in order to prevent concentration of barium chloride at the bottom of the tube during precipitation and to prevent agglomeration after precipitation. The use of the regular turbidimeter is limited to the estimation of sulphates from 30 to 600 parts per million. Less than 30 parts of sulphates were determined by comparison of the turbidity with that produced in waters containing known amounts of sodium sulphate treated with acid and barium chloride. These standards of course cannot be carried in the field, but it is possible for a skilled observer to estimate from memory below 30 parts certainly within 50 per cent. Above 600 parts the water was diluted to a convenient strength with water free

from sulphates before precipitation. The best results are obtained in readings on waters containing between 56 and 265 parts of SO_4, and it is best to dilute to bring the readings between these limits.

The average error of the tests of the 27 waters containing more than 30 parts per million was 10 per cent. For turbidimeter readings between 2 and 19 centimetres the average error is 8.5 per cent. For readings less than 2 centimetres and for sulphates greater than 600 parts, the errors of single estimates are much greater, averaging 15.4 per cent. in the nine cases reported by Mr. Dole. Indeed, individual determinations of high sulphates are liable to great error.

In the laboratory tests for iron, "the iron in the residue from 500 cubic centimetres of water was removed as ferric hydrate and redissolved; then the amount of iron in this solution, or in an aliquot part of it, was estimated by the usual colorimetric method, the reddish hue developed by potassium sulphocyanide being compared directly or indirectly with that developed in standard solutions of ferric chloride. In the field tests, 45 cubic centimetres of water and 2 cubic centimetres of concentrated nitric acid are thoroughly mixed and allowed to stand 5 minutes; 3 cubic centimetres of a 2 per cent. solution of potassium sulphocyanide are then added." The red color of the solution was then compared with that of standard celluloid discs. This is the regular field method recommended by Leighton, with the exception that the coloring comparison was made immediately after the addition of the potassium sulphocyanide instead of 10 minutes later, as it was found that the compounds producing the red color are progressively decomposed by free nitric acid. In a second series of tests the mixture of water and nitric acid was allowed to stand one hour before addition of potassium sulphocyanide. It is apparent from the results that in most cases the iron is more completely oxidized if the second method is followed. The errors in the tests by the first method vary from 0.2 to 2.4 parts per million (8 to 100 per cent.) and in those by the second method from 0.1 to 1.0 (5 to 100 per cent.). The degree of change into the ferric form depends on the composition of the water and the chemical condition of the iron. Apparently much organic matter retards the change more than anything else in natural waters.

The estimation of the total content of scale-forming ingredients in the field is made difficult by the lack of satisfactory field methods for the determination of calcium and magnesium. The turbidimetric method proposed by Leighton for calcium is subject to great and uncertain errors, and the procedure devised by Catlett for magnesium has not yet been applied to water assaying. "The figure for total hardness obtaining by titrating a measured portion of water with sodium oleate tablets can be considered an approximate value for scale-forming ingredients up to 100 parts per million. Figures for total hardness greater than 100 parts are usually too low because of the interference of calcium and magnesium soaps with the reactions. For very hard waters an estimate of the probable scale can be made from the figures for total hardness, sulphates and bicarbonates. If the sulphates are computed to calcium sulphate and the bicarbonates to calcium carbonate and the two amounts added together, the sum represents the greatest amounts of calcium and magnesium compounds that could be made in the scale. An average between this sum and the total hardness by the sodium oleate method represents more or less approximately the amount of scale-forming material in normal hard waters. The relation may be expressed thus:

$$S = 0.41\ HCO_3 + 0.71\ SO_4 + 0.50\ H$$

in which S, HCO_3, SO_4, and H represent respectively the amounts in parts per million of scale, bicarbonates, sulphates, and total hardness. If this approximate figure is considered in connection with the amount of chlorides and the possible presence of hydrogen sulphide, as revealed by the odor, or of free sulphuric or hydrochloric acids, comparative classification in respect to steaming qualities may be made accurately enough for

reconnaissance work. This method of computation was successfully used in classifying 300 assays of waters made in Iowa and Indiana during a study of boiler-water conditions in those states.

"It may be concluded," Mr. Dole says, "that the assay tests for chlorides, sulphates, carbonates, and bicarbonates are as accurate as they need to be for preliminary work. The iron test is likely to give low results in many waters, and more time should be allowed for the oxidation of the iron. The test for total hardness, though laborious in hard waters, yields information valuable enough to make its performance worth while. The calcium test cannot be relied upon more than to indicate whether waters are high or low in calcium, and the results of this test should not be expressed in figures. In reporting results no decimals should be given except in iron, where one decimal place may be reported. The assays should always be made by persons having some knowledge of chemistry and a thorough training in the technique of the tests as well as an appreciation of their limitations."

THE IRON ORE RESOURCES OF THE WORLD.

AN ESTIMATE OF THE ACTUAL AND POTENTIAL RESERVES IN ALL COUNTRIES WHERE IRON ORE IS WORKED ON A CONSIDERABLE SCALE.

International Geological Congress.

IN 1908 the International Geological Congress initiated an international inquiry into the amount and distribution of the world's supplies of iron ore. The work is now completed and the results of the investigation, which probably represent the most accurate estimate of iron ore reserves yet made, have been published in a three-volume report which was presented to the Congress at the Stockholm meeting just closed. A brief summary of the report is taken from a review in *The Engineer* for August 26.

"The statistics have been classified into different groups; thus (*a*) includes such cases in which a reliable calculation of the extent of the deposit has been carried out; (*b*) includes those deposits in which only a very approximate estimate has been arrived at, and (*c*) includes such deposits as could not be represented in figures. Of the whole of the territory investigated 13.3 per cent. falls under group (*a*), 10.3 per cent. under group (*b*), and 51.6 per cent. under group (*c*), the remaining 24.8 per cent. not being accessible for inquiry. The area embraced by group (*a*), which consists of the greater part of Europe, with the exception of some of the Balkan States, as well as the United States of America and Japan, comprises 17,368,117 square kilometers; in this area 7,020 million tons of actual resources and 49,295 million tons of potential resources are known, the iron quotient (which is arrived at by dividing the quantities by the area) amounting to 404 million tons for the actual iron resources and 2,838 million tons for the potential resources. The total amount of known iron ore resources of the world is made clear by the following table, the quantities being millions of tons:

ORE RESOURCES OF THE WORLD.

	Actual Reserves.		Potential Reserves.	
	Ore.	Iron.	Ore.	Iron.
Europe	12,032	4,733	41,029	12,085
America	9,855	5,154	81,822	40,731
Asia	260	156	457	283
Australia	136	74	69	37
Africa	125	75	many thousands	
Totals	22,408	10,192	123,377	53,136

"As the production of pig iron at present can be stated in round figures to amount to 60 million tons yearly, the supply hitherto known of actual ore resources would not be sufficient for two hundred years, on the supposition that the production of pig iron remained stationary. To what extent the future of iron will become dependent upon low-grade ores becomes apparent from the following figures, showing the comparatively small remaining supplies of ores which contain more than 60 per cent. of iron:— The actual supplies of these rich iron resources are 1,300 million tons, and the potential 687 million tons, and the amounts of iron in these ores are 850

million tons actual and about 408 million tons potential. Four-fifths of the known and recorded rich ores come from the deposits of northern Sweden.

"In Europe the greatest actual ore reserves are the minette ores distributed between Germany, France, Luxemburg and Belgium, amounting together to about 1,850 million tons of metallic iron, Next in order come the ore reserves in the north of Sweden with about 673 million tons. Amongst the potential resources, the clay-ironstones of Great Britain, chiefly divided into two centres, viz., one in England and Wales, with 7,100 milion tons, and the other in Scotland, with 2,400 million tons, are first. In North America the most important ore resources lie in the Lake Superior region, with about 2,000 million tons actual and 36,000 million tons potential expressed in metallic iron. Next to these are the considerable deposits in Newfoundland, with about 1,960 million tons of actual reserves. In Cuba there are about 857 million tons actual and 454 million tons potential reserves. In South America only one single important iron ore centre is known, and this is situated in the province called Minas Geraes; it contains at least 3,055 million tons of potential iron reserves. There are no definitely fixed iron ore centres in Africa, while in Asia and Australia no important centres are known.

"The report on the iron ore reserves of the United Kingdom was drawn up by Prof. Henry Louis, who estimates the resources of the United Kingdom as follows:

	Tons.
Stratified iron ores of the carboniferous formation	34,000,000,000
Stratified iron ores of the secondary formation	5,000,000,000
All other iron ores	500,000,000
Total iron ore	39,500,000,000

As the average iron contents of these ores range from 30 to 35 per cent., the above total corresponds to about 13,000 million tons of iron. At the present time the United Kingdom produces about 15 million tons of iron ore annually which is about 5 million tons of metallic iron. It is thus obvious that the iron resources of the country are fully equal to the demands that the future can possibly make upon them, if regard is merely had to quantity. But it must be pointed out that in these figures no attention has been paid to the question whether these ores can or cannot be worked with profit, and it may be said that the largest proportion of the above quantities cannot be profitably worked at the present time. It is, however, considered by no means impossible that some change may render of commercial importance many ores which are useless to-day, seeing that the data given in the report are concerned with true iron ores, namely, such as contain at least 25 per cent. of metallic iron.

"A classification of the ore reserves of the German Empire has been made by Mr. G. Einecke and Mr. W. Köhler. Taken altogether, the ore resources of the German Empire are as follows:—Actual, 2,840 million tons; potential, 1,067 million tons. To this is to be added a very great amount which the authors have not yet found it possible to express numerically. According to Mr. P. Nicoll, who has written the report on the iron ore reserves of France, the three classes of ore which predominate in the country are the minette ores in Lorraine, the Silurian ores in Normandy, and the ores occurring in the form of veins in the Eastern Pyrenees—amounting altogether to 95 per cent. of the resources of the country. Taken altogether, the available ore reserves in France may, in round figures, be estimated at 3,300 million tons at least. As regardes Belgium, Mr. Georges Lespineux finds that the total of the reserves of ore is 62½ million tons.

"Spain may be considered as a country possessing considerable iron ore reserves, which Mr. Louis M. Vidal estimates at 711 million tons. Portugal, on the other hand, is poor in iron ore deposits, and the estimated amounts do not exceed 17 million tons of ore in sight, and 58 million tons which may be classed as probable. In European Russia, the principal deposits of iron ore are the Central and Southern Russia, the Urals, Poland, and the Caucasus, the total reserves of which are estimated by Mr. K.

Bogdanowitsch to amount to 1,921 million tons. Some of the iron ore reserves of Sweden are to be accounted among the greatest in the world, and are now almost exclusively being mined for export. The actual reserves of the country are estimated at 1,178 million tons, and the potential at 224 million tons. The reserves of Norway may be put in round figures at 350 million tons, containing 30 to 36 per cent. of iron.

"Prof. J. F. Kemp, of Columbia University, estimates the actual ore reserves of the United States of America to be 4,257 million tons and the potential reserves are calculated as 75,105 million tons. The potential reserves of Brazil have been calculated to amount to 5,710 million tons, but this estimate might be multiplied several times over when the country has been fully examined. The iron ore reserves of Asia are, on the whole, little known. The actual total is 260 million tons, 100 million tons of which are credited to China and 55 million tons to Japan. No estimates are made of the iron ore deposits of the Transvaal or Cape Colony."

STEEL BELT CONVEYORS.

A BRIEF DESCRIPTION OF STEEL BELT CONVEYORS RECENTLY PUT IN OPERATION IN SWEDEN.

Alfred Gradenwitz—Engineering and Mining Journal.

WE have already described in these columns* the recent application of steel belts to power transmission in Germany. It is now reported by Alfred Gradenwitz in the *Engineering and Mining Journal,* for September 3, that after several years of experimentation steel belt conveyors have been placed on the market by a Swedish steel firm, and are giving very satisfactory and economical service in a number of installations in northern Sweden.

So far, the steel belt conveyors have been manufactured in lengths up to 100 metres, in widths of 8 to 16 inches, and in thickness from 0.03 to 0.04 inch. The lengths are readily riveted together to form any required length, and wherever any special width is required, two or more parallel belts can be arranged side by side. The material used is a high-grade charcoal steel. The belts offer high resistance to tensile stress and abrasion and are at the same time extremely flexible. They are adapted to the carriage of all kinds of material, and are cheaper to construct and install than high-grade belts of other materials. One important reason for their cheapness is the comparatively few idler pulleys required. The maintenance cost is small and repairs are easily made by simply riveting in a section of any desired length. A low power consumption is the result of the low coefficient of friction, the smooth surface of the steel and the storage of the energy expended in bending the belt around the pulleys instead of its conversion into heat.

Troughing of the belt itself is, of course, impracticable, and the steel conveyors are installed in a trough of wood lined with sheet metal or wholly of metal, the sides of which may be inclined 15 degrees without danger of obstruction. Any contact between the belt and nail heads must be avoided. To prevent the belt from lifting off the trough, due to the accumulation of material underneath, the longitudinal elevation of the conveyor must be straight or slightly convex. By proper construction of the joints, any material accumulating beneath the belt may be made to travel in the direction of transport and discharged through a hole in the trough in front of the belt pulley.

An ordinary wooden drum, built up of planks, the periphery covered with a layer of rubber belting, 3 to 4 millimetres thick, gives satisfactory service as a belt pulley. The axles are centred in cast or forged plates, fixed to the side walls of the pulleys. Cast-iron pulleys are usually unnecessarily expensive. When they are used they should be covered with wood and rubber, the rubber

* The ENGINEERING MAGAZINE, December, 1909.

being for the purpose of compensating for the buckling and scratching effect of material between the belt and the pulley. The pulley bearings should be made capable of adjustment through 100 to 150 millimetres in the direction of travel, the two sides being adjusted independently. Idlers are used for supporting the returning side of the belt, and in large installations a few idlers are used advantageously to preserve alignment. The distance between supporting idlers is about 10 metres, with the last placed about 3 metres from the belt pulley. They are made of cast iron or wood, preferably the latter, and are from 40 to 50 centimetres in diameter. The bearings of all idlers should be capable of adjustment.

The belt sections are joined by ordinary lap joints with two rows of rivets 4 millimetres in diameter and 30 to 35 millimetres apart. The triangular lap is most satisfactory. In making the final joint the ordinary type of belt stretcher is used. The joints are lapped about 60 millimetres, the inside surfaces of the belt ends being coated with some rust-preventing material.

In installing steel belt conveyors it is best to provide for charging the material as far as possible from the rear belt pulley, in order that the pulley may be readily accessible. One of the advantages of the steel belt is the ease with which even the finest materials may be discharged at any point by means of a scraper. The capacity of the conveyor is proportional to the speed and approximately to the square of the width. Under ordinary conditions 50 metres per minute is a suitable speed, though in some cases a speed of 100 metres per minute should be reached. The proper belt width depends upon the kind and quantity of material to be transported. For planks, timber, etc., the belt width should be 1.5 times the width of the individual pieces; for ore, charcoal, firewood, blocks, etc., the belt width should be at least equal to the maximum length of the pieces; and for sawdust, shavings, and other waste materials, the belt should be wide enough to carry the materials without their coming in contact, to any considerable extent, with the side walls of the trough.

While, in general, the power consumption is low, for the reasons given above, it depends upon the kind of material transported, the weather conditions and other factors. One belt 120 metres between pulleys and 400 millimetres wide, installed to convey 50 cubic metres of charcoal per hour at a speed of 50 metres per minute, requires, including the gear and motor, about 3.6 electrical horse power at no load and 5.1 horse power at full load; in this case the gearing and motor alone absorb 2.1 horse power. In another plant two parallel belts, 300 millimetres wide and 150 metres long, transporting 100 cubic metres of charcoal per hour at a speed of 50 metres per minute, require at no load 6.3 horse power and at full load 9 horse power. In a third installation, for transporting chopped firewood, a belt 410 millimetres wide and 80 metres long requires, when full and travelling at a speed of 50 metres per minute, about 4 electrical horse power.

REFUGE CHAMBERS IN COAL MINES.

A DISCUSSION OF THEIR LOCATION, DESIGN, EQUIPMENT, AND COST.

George S. Rice—West Virginia Coal Mining Institute.

GENERAL interest in the systematic establishment in coal mines of refuge chambers equipped with means of communication with the surface and stored with food, water, and medicines, has been awakened by the history of recent mine explosions in the United States. The notable recovery of 20 living men from an improvised refuge chamber in the Cherry mine, a week after entombment, is a case of especial interest. There is no doubt that in the majority of recent disasters men in certain portions of the mines have not been killed outright, but have lived for hours and even days after the explosions, final-

ly losing their lives in fruitless wanderings in search of means of escape. If these men had had at their disposal refuge chambers with telephone connection with the surface, with a supply of food, water and good air, they could have awaited rescue with perfect safety.

George S. Rice, of the Technologic Branch of the United States Geological Survey, has discussed the design, equipment and cost of refuge chambers in a recent paper before the West Virginia Coal Mining Institute, printed in the *Engineering and Mining Journal* for August 27. "The majority of mine disasters," he says, "are due to explosions, and most of them in this country have their origin at the working faces. Usually the main explosive wave rushes along the haulage road that provides its fuel—coal dust—until it reaches the exits into the open air. There are frequently branch explosive waves that traverse some of the cross headings or entries. More particularly is this true when the rooms are connected through from heading to heading and provide an abundant supply of fresh, dry coal dust. In exceptional cases, notably at Marianna, Penn., and recently at Mulga and Palos, Ala., the flame of the explosion has penetrated throughout the mine. In these mines there was a small amount of methane given off in the working faces, which undoubtedly tended to widen the explosion in each case. In a typical coal-dust explosion where there are some wet stretches of passageways, wet from either natural or artificial causes, there are likely to be some roads and districts unpenetrated by flame. This suggests the value of a refuge chamber in each district and a complete separation of one district from another by continuous pillar, where the room-and-pillar system is used. The entrance and exit for haulage and ventilation of each district should be located at one point and the entrance and exits protected by special zones which are kept free from dust, or the dust thoroughly wetted or covered by rock dust.

"Such information as we have at present leads to the belief that these zones can be made impenetrable to an external dust explosion when uncomplicated by the previous presence of methane in the air passing through the zones. The latter would be an exceptional condition. An explosion within a given district would probably traverse its respective protection zone and possibly reach the nearest exit to the open air, but the explosive wave should not enter the other districts if the inert zones are properly arranged and protected.

"Suppose, then, there be a refuge chamber in each isolated district, the miners acquainted as they should be with the location of the chamber, rush to it on hearing the explosion or being notified of it if in a distant district. In an inclosed district, the afterdamp would come in only slowly at the entrance until the explosion doors at the fan had been replaced, so that in most cases in a carefully planned district the men would have ample opportunity of reaching the refuge chamber before the blackdamp drifted or was blown in. Such a chamber should be connected by a protected telephone line with the surface, preferably coming down a drill hole direct into the chamber. This drill hole could also be used for suppying fresh air under pressure. Under such circumstances, the imprisoned men, encouraged by communication with the outside and supplied with stored food and water, could live for weeks, if necessary, until safely reached by rescuers."

While the maximum size of a refuge-chamber district will depend somewhat on the geological and physical characteristics of the seam and the method of working, it is desirable to have it bear some relation to the maximum number of men employed in a district ventilated by a separate split of air. A common maximum is 100 men per split, but as new districts or panels are forming while others are being worked out, the average number employed in a district may be taken as 50. A medium-sized mine employs about 200 men on the day shift, and a large mine about 500. In medium-sized and large mines, therefore, there will be from 4 to 10 live districts for which refuge chambers will be required.

If these chambers are provided for in

laying out the mine, the cost per ton will be insignificant. The drill holes put down in prospecting or for the drainage of gassy seams, if cased and protected from injury at the surface, serve as the most valuable feature of the refuge chamber. While the refuge-chamber drill holes are better large, the ordinary prospect hole which may be cased with a 2-inch pipe will accomplish all that is strictly necessary. A larger internal diameter may be obtained if the holes are bored on the Brejoha system and lined with cement.

Oxygen rescue apparatus supply 2 litres of oxygen per minute, more than sufficient for a man at rest. About 10 litres of free air per minute will be required per man, or, assuming a maximum of 100 men in the chamber, 1,000 litres per minute of air at atmospheric pressure, equivalent to 60 cubic feet of air per minute compressed to 80 pounds per square inch, a quantity which could easily be delivered by even a 1-inch pipe to depths of over 1,000 feet. The exhaled and surplus air will be discharged into the mine. The installation of a hand-driven suction fan at the bottom of the hole, making the refugees independent of external machinery to get air, has been suggested; such a fan should be offset from the foot of the hole by means of a tee, and valves should be inserted to permit the use of the hole for other purposes.

To allow a man to stretch out on the ground, about 12 square feet of space is required. The chamber would require, therefore, an area of 1,200 square feet to accommodate the maximum number of 100 men. It may be an ordinary working room and driven as such, though for the sake of speed in preparation it may be advisable to limit its length to 100 feet. "The chief features to be observed are (1) to make the room neck or necks of great length; (2) to make the pillars on either side of good thickness, and make the crosscuts to adjoining rooms or entries in the process of driving the room as narrow as possible, so as to lessen the difficulty and expense of building tight masonry or concrete stoppings in same on completion of the chamber. Where the State laws do not require crosscuts nearer than 80 to 100 feet, the refuge chamber could be driven up without crosscuts, using instead a line brattice to carry ventilation to the face.

"The entrance to the chamber, after the crosscuts have been securely and strongly sealed, should be at the heading or entry only. There should be two entrances at the heading where practicable. The reason for two is to provide for ventilation under ordinary conditions, and in case there should be a fall of roof on the entry, blocking one of them, the other entrance would be available. The entrance used in driving the chamber would have to be wide enough to admit a mine car, though this width should subsequently be reduced by heavy masonry securely keyed into the ribs to keep down the width of the doors to about 30 inches. The other entrance could be driven narrow by pick. Normal ventilation would be established by placing a curtain across the entry or heading, and if necessary, carrying a line brattice up the room.

"Opposite one of these entrances there should be a crosscut, with doors through the pillar to the parallel heading or entry to allow the men to enter from that side. The entrances into the chamber should each be guarded by at least three strongly built doors with frames recessed into the rib or masonry. It does not seem essential that these be made of iron. It is rare that fires resulting from explosions are started in the interior of the mine, without immediate extinguishment by the afterdamp. When fires result from an explosion it is usually near the entrance, where the fresh air has come in before the coked dust has cooled off. There is no objection whatever to iron doors, but it is better to keep down the expense of installation and have frequent refuge chambers instead of one or two very expensive ones. The doors should open inward to the chamber and normally be kept open by a button, though self-closing. This applies to district chambers in the interior of the mine and not to a special fireproofed chamber, such as has been proposed for in-

stalment at an escape shaft, and in which it may be better to keep the doors closed. The first men entering the district would shut the doors. The doors should be carefully hung and fit tight, but no extra or unusual tightness would be required if there was a cased drill hole from the surface, down which air could be forced under pressure. It might, in fact, be found necessary to provide the pipe recessed along the rib behind the door casings with an automatic relief valve in same to prevent excessive air pressure on the men, should the doors seal very tightly."

In shaft mines, one chamber near the shaft would be advisable, fireproofed and equipped with iron doors, to provide a refuge for men who might be able to reach the bottom after any explosion before the hoisting arrangements, if injured, had been repaired, and also for use as a hospital and a base for rescue parties. Shaft arrangements vary so widely that it is not possible to specify the size and shape, but the general equipment would be the same as for the district chambers.

In all cases signs and directions should be placed along the headings leading to the chambers, and each new employee should have carefully explained to him the location of the chambers and the use of the equipment. The chambers should be whitewashed and the floors kept swept.

As to the equipment needed, Mr. Rice mentions specifically the telephone, which should be of the iron-encased type; a privy, located in a rib hole or one of the sealed crosscuts and provided with sand and disinfectants; drinking water, kept in covered casks and renewed from time to time; food in cans and tins, a dozen or more dry-cell electric lights, and two or three safety lamps with match relighters, all stored in wall cases with glass fronts; one oxygen resuscitation box with an extra oxygen cylinder, two or more oxygen rescue apparatus, and two or more portable chemical fire extinguishers; a roll of canvas or brattice cloth; and disinfectants, simple medicines, and a box containing first-aid remedies and implements. This list, of course, can be added to indefinitely, but it is much more important to have the apparatus and supplies so maintained as to be instantly available than to have an elaborate equipment.

The following estimate of the cost provides for a good equipment. Apparatus mentioned above and not included in the estimate should be considered as part of the mine equipment. The room is not considered an added expense, except for the extra length of neck. The cost of drilling the hole is considered part of the cost of prospecting; the cost of casing for an assumed depth of 500 feet is alone considered. The telephone is not regarded as an extra cost.

ESTIMATED COST OF REFUGE CHAMBER.

500 feet 2-inch pipe casing, in place	$50
50 feet excess room neck yardage and special entrance	50
5 room crosscuts, say 100 feet of yardage	50
5 masonry stoppings at $10	50
6 masonry door frames at $5	30
6 doors and frames at $6	36
Sanitary closet and fixtures	15
Wall cases with glass fronts	20
Casks, pails and miscellaneous fittings	10
Food in tins and cans	25
6 dry-cell electric lights at $5	30
2 safety lamps at $5	10
Oxygen resuscitation box with two cylinders	45
First-aid box, medicines and disinfectants	25
Miscellaneous, say	54
Total	$500

The surface arrangements for air supply will vary according to the topography and ownership of the surface, and the regular mine equipment. If the mine has an air compressing plant, it is most satisfactory to connect the top of each refuge-chamber drill hole with the central compressor plant. If there is no compressor plant but an electric plant, a small motor-driven compressor can be used for each hole, or in case the hole is large enough and not too deep, a high-speed blower. The telephone line, which will be used for the regular business of the mine, should run to the central plant or office. The cost of the surface equipment when compressed air is available would be merely the cost of the outside pipe lines, which need not be large, probably $1,500 to $2,000 for a mine with six chambers. When electric power only is available, the cost of transmission line and motor-driven fan or compressor will probably not exceed $500 for each drill hole. The cost of refuge chambers for an average mine will not exceed $10,000.

PEAT INVESTIGATIONS IN CANADA.

A REVIEW OF THE WORK UNDERTAKEN BY THE DEPARTMENT OF MINES TO DEVELOP THE PEAT INDUSTRY.

Eugene Haanel—American Peat Society.

CANADA has attacked the problem of peat utilization in a highly practical manner. Some three years ago a Commission was sent abroad to investigate the technical and economic aspects of the peat-fuel industry in Europe. A systematic campaign for the development of Canada's immense peat resources, based on the report of this Commission, has now been undertaken by the Department of Mines. A large bog has been acquired by the Government, where peat fuel is being produced on a commercial scale by a method which has proved successful in European practice. In Ottawa a testing plant has been estabished, where an extended investigation of the production of gas power from peat is now under way. Finally, an examination of the most easily accessible peat bogs by the peat experts of the Department is in progress. It is reasonable to expect from this method of procedure the establishment on a sound financial basis of an extensive peat-fuel industry.

The expectation is strengthened by a perusal of Dr. Eugene Haanel's recent address before the American Peat Society, which sets forth the principles guiding the Canadian authorities and the economic situation of Canada as regards fuel supply. The Commission referred to above found that all endeavors to accomplish economically by artificial means in a short time what has been accomplished by nature in exceedingly long periods of time, namely, the changing of peat into a substance similar to coal, have so far not led to commercial results, and after trial have been abandoned. It has been decided, therefore, to introduce only such processes and such machinery as have proved commercially successful in Europe, leaving experimentation and the development of new ideas to the future, when the peat industry has been placed on a secure basis. To quote Dr. Haanel:

"To re-establish the confidence of the people of Canada in the value of peat as a domestic and industrial fuel, and to stimulate renewed activity in the development of our peat resources, the Government has acquired 300 acres of peat bog, with an average depth of 9 feet, for the purpose of manufacturing peat fuel on a commercial scale, and by a method which has proven successful in European practice. At this plant interested parties will have an opportunity of ascertaining for themselves the working of the bog as well as the suitability of the peat fuel produced. The capacity of our plant is a production of 30 tons per day. For a large commercial plant, mechanical excavators should replace the manual labor empoyed at our plant, if the bog to be exploited is suitable for this class of labor-saving machinery.

"The plant at Alfred is to serve as a model of a successful process, and not for the production of peat fuel on an extensive scale. We expect, however, to manufacture during this season, about 2,000 tons of peat fuel, part of which is to be used in our peat gas producer at Ottawa. Allowing 140 days for a season's operation, the cost per ton of air-dried machine peat, including interest on capital invested, amortisation, oil and repairs, is as follows:

Cost of fuel on the field	$1.40
Cost of fuel stored in shed	1.65
Cost of fuel loaded on car	1.65
Cost of fuel in stack	1.70

By the employment of mechanical excavators and the manufacture of peat on a large scale, the cost of production per ton should be considerably less than the figures here given.

"The objection to the air-drying process, practiced at our plant, is that it is not a continuous process, that it can be worked only during the summer months, and that the amount of fuel which can be produced during one season is dependent upon weather conditions. These statements are quite true,

and yet Sweden, Finland, Denmark, Germany, Holland, Austria, and Russia depend for a large part of their fuel supply on the simple process of pulping the peat, forming it into bricks upon the field and harvesting it as air-dried fuel. The weather conditions in Canada are as favorable, if not more so, for the production of air-dried machine peat as in the countries mentioned. To prevent shortage of peat fuel on account of unfavorable weather conditions during a season's work, a year's supply of peat fuel should always be kept in storage. . . . .

"The economy which may be effected by the use of peat is readily understood when it is stated that in Ontario and Quebec the average price of anthracite with a high percentage of ash, is $7.50, and in Manitoba $10.00 per ton, whereas air-dried machine peat, containing only about 5 per cent. of ash can be manufactured at a cost of considerably under $3.00 for an amount having the same calorific value as a ton of the anthracite we import. This could be sold at places conveniently situated as regards transportation facilities and not too far from the place of manufacture for a little more than one-half the price paid for anthracite in Ontario and Quebec, and for a little more than one-third of the price paid for anthracite in Winnipeg.

"Some few years back the labour troubles in the United States taught us a lesson which should be heeded, and which should enable us to conceive what a real fuel famine would mean for Canada. Anthracite coal in Ottawa at that time was sold at $12.00 per ton. What if it could not be got at any price, and if we had to pay the transportation costs of fuel from either Nova Scotia or the far West? Who can even imagine the suffering it would entail upon our population? It is very easy to say that such a state of affairs is not likely to occur, but who will guarantee that it might not? The central provinces of Canada have accumulated no stores of fuel ready to be drawn upon in cases of emergency. We import what we need from year to year, and any shortage of supply from whatever cause affects seriously our industries and the comfort of our people.

"We cannot afford, in the light of past experience, to waste capital on the experimentation for the discovery of processes which shall be continuous in operation and furnish a fuel from peat similar to coal, nor can we wait until someone at some time in the future will invent such process and demonstrate its commercial possibilities. Neither should prospective manufacturers listen to the marvellous representations made by promoters of schemes and processes, which promise great profit for production at excessively low costs of a peat fuel superior to anything yet put upon the market, but wisely adopt processes which are already an assured commercial success in the peat-using countries of Europe.

"The peat bog at Alfred was acquired by the Government for the purpose of demonstrating to prospective manufacturers of peat fuel one of these processes, and to prevent failure from choosing bogs unsuitable for their purpose the Mines Branch has recently undertaken a systematic investigation of the more easily accessible peat bogs. In carrying out this investigation, our peat expert has been instructed to determine and map their extent, ascertain their depth, and also the quantity, character, and calorific value of the peat contained in them. So far, twelve bogs have been investigated, mapped, and reported upon. In case of need, the staff performing this work can be increased to meet the requisitions made upon the department.

"The successful inauguration of a peat fuel industry in Canada may be looked forward to with confidence if, content to accept European practice, we establish peat plants at strategic points on the workable bogs scattered throughout the farming regions of those provinces which require to import coal, and operate them in the interests of the neighbouring communities. This will avoid long hauls, for which air-dried machine peat is not fitted. . . . . .

"To demonstrate the value of peat for the production of power for industrial purposes, a modern German peat-gas power plant has been erected by the department in Ottawa. Its capacity is 60

horse power, and consists of a double fire zone Körting peat-gas producer, with the necessary gas-cleaning apparatus, and a Körting four-cycle single-acting gas engine direct connected to a Westinghouse 50-kilowatt direct-current generator. While no definite figure can at present be given of the consumption of peat per brake horse-power hour, since the investigation begun some time ago is not yet completed, our preliminary trials, however, bear out the results obtained in Swedish and German plants, where the amount of peat consumed per brake horse-power hour ranges from a little over 2 pounds to about 3 pounds, depending on the calorific value of the peat employed. Since the peat of the different bogs so far examined has a high calorific value, we expect that our figure for the consumption of peat per brake horse-power hour will be in the neighbourhood of 2 pounds.

"The erection of gas producers designed for the recovery of by-products is not recommended except in localities where such by-products would command a ready and profitable market. In Canada it is far more economical to aim at the complete gasification of all the heat elements in the fuel. Peat-gas producers for power purposes should, whenever possible, be erected on the bog, and the energy generated in the form of electricity transmitted to neighbouring towns and villages for power and lighting purposes as in the case of water power. This is the policy adopted in European countries. Whatever other valuable products may be obtained, such as moss litter, peat mull, alcohol, packing paper, millboard, ammonia and nitrates, the great and important need for us in Canada is the production from the peat deposits of a reliable supply of fuel for domestic and industrial purposes.

"When this has been attained and peat fuel is put on the market in abundance and sold at a reasonable price, we shall not alone have rendered ourselves to a great extent independent of outside sources for this necessity, thus enabling us to retain in our own country a large part of the capital now spent annually for the purchase of fuel from abroad, but a new era of industrial development will dawn upon our nation, and we shall here see repeated what has been accomplished in Europe—the establishment of large industrial concerns on the waste areas of our country underlaid by peat, and the wide stretches of these solitudes will become resonant with the welcome sounds of industrial activity."

FAILURES OF GAS ENGINE CYLINDERS.

A DISCUSSION OF THE CAUSES OF CRACKS IN GAS ENGINE CYLINDERS AND METHODS OF PREVENTION AND REPAIR.

Prof. Langer—International Mining Congress.

THE difficulties of gas-engine cylinder design, which has always been the greatest of the mechanical problems connected with the combustion motor, have been successfully solved so far as small and moderate-sized units are concerned, but the cylinder still remains the weak point of engines of really large dimensions. Improvements in construction and reduction of the working pressure have considerably lowered, but by no means removed, the danger of cracking. Dugald Clerk, in a paper reviewed in these columns in THE ENGINEERING MAGAZINE for November of last year, expressed the opinion that a new thermodynamic cycle will have to be adopted for large gas engines before any permanently successful development can take place. Prof. Langer, who reviewed recent experiences in working large gas engines in Europe at the recent International Mining Congress at Düsseldorf, suggests that the solution of the problem depends upon the production of a material of which the product of the co-efficient of expansion and the modulus of elasticity is lower than in the case of cast iron, without sacrifice of tensile strength. We quote at length from Prof. Langer's comments on cylinder cracking, after an

abstract of his paper in the *Iron and Coal Trades Review* for August 26.

"The uncertainty still prevailing as to the actual cause of cracking is evident from the circumstance that some makers turn out jacket and cylinder in one piece, whilst others build up both from parts. The latter type of construction has arisen chiefly from the desire to obviate axial casting stresses, which place the inner cylinder in tension, as also from the endeavor to secure compactness in the metal at the admission and exhaust connections. On the other hand, the first-named type gives an improved transmission of strains between the cylinder and the engine frame or intermediate piece. This type preponderates in Germany, but in America about 40 per cent. of the engines have built-up cylinders, divided at right angles to the axis. As a matter of fact, the built-up cylinders have remained free from cracks due to tension stresses, whereas the solid type frequently exhibits cracks between the head flange and the cylinder flange. A close investigation of the cause, however, shows that the dangerous flexion stresses have been overlooked in the desire to protect the flexibility of the wide flanges, which stresses are set up at the rounded junction between cylinder and flange, by any axial force acting in the cylinder. This defect, which is not inherent in the single-piece cylinder, is absent in the built-up cylinder, the seat of danger being of stronger construction for other reasons, and all dangerous stresses between head and cylinder being prevented by suitable packing. For extraneous reasons the flexion stresses at the seat of danger are so different in the two classes of cylinder that the appearance of cracks in the single-piece cylinder is no proof of the danger of casting stresses; and, indeed, the examination of single-piece cylinders that have been broken up has demonstrated the harmlessness of axial casting stresses, the cracks being invariably formed where the cylinder and junction had been further weakened by a considerable displacement of the core. Though the stresses would necessarily be greater in the thicker portions of the metal where the core had been displaced, the cracks always appeared in the thinner places, which had been subjected to excessive mechanical strain.

"The causes producing cracks in the walls of the combustion chamber are of an essentially different character. The fact that these cracks always form in places where the transmission of heat to the cooling water has been obstructed in some way indicates that their immediate cause is to be sought in the stresses arising from inequality of temperature in different strata of the wall at that place. At such places the maximum temperature of the metal nearest the combustion chamber will greatly exceed the normal during the expansion and exhaust strokes, so that compression stresses are set up in the hotter strata and tension streeses in the cooler strata. During the two strokes aforesaid, the state of stress of the metal is comparable with that of a bar that is bent toward the inside of the cylinder. On the intake valve being opened, cold air enters, and cools the inner surface of the combustion chamber, whereas the central portion of the metal is not cooled to anything like the same extent. Consequently the surface metal is subjected to a considerable tension, the effect being similar to that produced by a sudden bending outward to an extent proportional to the product of the greatest momentary difference in temperature between the surface and centre of the metal, and the co-efficient of expansion of the metal. The stresses are the product of the difference of temperature, co-efficient of expansion and the modulus of elasticity.

"It would be difficult to find another example of such unfavorable stress, owing to the rapidity with which the injurious changes of temperature succeed one another in the gas-engine cylinder; and the actual extent of the stresses cannot be calculated, owing to the impossibility of ascertaining exactly the distribution of temperature in the walls during the various phases of the complete cycle of the engine. If, however, it be remembered that a difference of 100 degrees C. in temperature produces

a stress of over 14,000 pounds per square inch when the longitudinal expansion of the metal is prevented, it can only be a matter for surprise that such cracks are not even more frequent. The formation of a crack of only a few millimetres in depth is sufficient to relieve the stress, so that if observed in time, the extension of the cracks can be prevented by chiselling, drilling and stemming with soft copper. This, however, is unavailing when the crack has penetrated deeper, the high co-efficient of expansion of the copper then tending to burst upon the crack. On the other hand, the cracks are difficult to locate in the early stages, since they do not gape when the metal is cold; and therefore preventive measures must be adopted, viz., reducing the differences of temperature in the wall to an innocuous degree. This involves the suppression of irregular ignition and incomplete combustion on the one hand, and the improvement of heat conductivity on the other (avoidance of any accumulation of material that can lead to the formation of cavities and so lower the conductivity). Other features to be strictly avoided are highly convex junctions, which accumulate heat on the one hand and are particularly exposed to the cooling action of the incoming air on the other, both of which conditions predispose to the formation of cracks. It is therefore evident that the bulbed shapes of the admission and exhaust connections—which result in convex junctions with the cylinder, and are solely designed to take up the force of the explosion and to shorten the length of the engine—are unfavorable so far as the combustion chamber is concerned.

"The inevitability of rapid changes of temperature during the working cycle of the engine, and the impossibility of obtaining perfect equality in the transmission of heat to the cooling water in all parts of the combustion chamber walls, preclude absolute success in preventing cracks and necessitate the attempt to reduce the factor resulting from the product of the co-efficient of expansion and the modulus of elasticity of the metal. The problem will be solved when a material is produced in which this factor is lower than is the case with cast-iron, without sacrifice of tensile strength; and when that is achieved, the life of the gas-engine cylinder will be equal to that of the steam-engine cylinder. The failure of the endeavours to supersede cast-iron by steel in gas-engine cylinders is due to the factor in question being about four times as great as in cast-iron, while the resistance of cast-steel to the alternating stresses is barely thrice that of cast-iron."

THE ECONOMICS OF RAILWAY ELECTRIFICATION.

A DEFENSE OF THE DIRECT-CURRENT SYSTEM AND A DISCUSSION OF THE POSSIBILITY OF STANDARDIZATION.

William Bancroft Potter—American Society of Mechanical Engineers.

LAST month we reviewed in these columns the paper read by George Westinghouse at the recent joint meeting of the American Society of Mechanical Engineers and the Institution of Mechanical Engineers, recommending the early adoption of a standard system of railway electrification for universal use. While Mr. Westinghouse expressly disclaimed advocacy of any particular system, his paper exhibits a quite natural partiality for the single-phase system, the most notable example of which, the New Haven terminal equipment, his company installed. Entirely different opinions, both as to the desirability of standardization and the relative merits of the direct-current and single-phase systems, were expressed by at the same meeting by William Bancroft Potter, of the General Electric Company, a part of whose paper is reproduced below.

"There would undoubtedly be an advantage," he says, "in having the character of the energy supplied to the contact conductor uniform, but this is out of the question on account of the great

difference in the requirements of specific conditions, such as congested urban or suburban service and comparatively infrequent trunk line train movements.

"The sub-station and rolling stock may be equipped for operation with direct current or alternating current, single phase or three phase, and what is commonly spoken of as 'the system' usually refers only to that part of the general scheme of electrification which comprises the sub-station and rolling-stock equipment. There are exceptional cases where the power-station and transmission lines have direct relation to the rolling-stock equipments; but with the development of the alternating-current transmission this is less frequently the case than it was a number of years ago, when 600-volt power-stations supplied power directly for the operation of 600-volt motors.

"The development of apparatus for higher voltage direct current has so far increased its scope that direct current at either 600 voltage or higher may be considered the most economical for city and interurban service, and for the electrification of steam railways where the density of traffic is sufficient to require a relatively large investment for rolling stock, as compared with that required for the secondary distribution system and the sub-station apparatus.

"Single-phase and three-phase rolling-stock equipments are applicable only to exceptional conditions. The reason for this is the greater first cost of such equipments. This is especially true when comparing single phase with direct current. The type of equipment used on the rolling-stock may well be a more important factor in the economy of investment and operation that the scheme of power distribution.

"Under the conditions which exist in America, direct current and single-phase are applicable to either level or grade work; while three-phase will probably be limited to the latter where its regenerative feature of returning energy to the line may be of value. The relative economy of the different systems of electrification is dependent on the density of traffic and the character of power available, rather than on the length of the railway.

REASONABLE VALUES FOR TRUNK-LINE SERVICE.

	Sub-Stations. 600 v. D. C.	1200 v. D. C.	11,000 v. 1-Phase.	11,000 v. 3-Phase.
First cost per kilowatt complete	$26	$28	$11	$12
Comparison of installed kilowatt, per cent.	200-250	100-125	100	100-125
Load factor, machines in service, per cent.	20-40	35-70	40-80	30-60
Average efficiency, per cent.	78-88	87-92	97-98	97-98
Yearly operation and maintenance, each station	$5,000	$5,000	$2,500	$2,500
Contact Conductors.*	**Third Rail.**		**Overhead.**	
First cost, per mile	$5,000 to 7,000	$5,500 to 7,500	$3,500 to 7,000	$4,500 to 8,000
Efficiency, per cent	88-92	90-96	93-97	93-97
Maintenance per mile per year.	$75-125	$100-150	$100-200	$125-250

* Variation in cost of third-rail due to different weights of rail which may be required. Variation in cost of overhead due to variation in the class of construction, such as with wooden poles or with steel bridges.

Rolling Stock.†	600 v. D. C.	1200 v. D. C.	11,000 v. 1-Phase.	11,000 v. 3-Phase.
Locomotives.				
First cost, each	$44,000	$47,500	$64,000	$58,000
Weight, tons (2,000 lb.)	125	125	160	160
Average efficiency, locomotive wheels to trolley, per cent	85	85	79	81
Maintenance per locomotive mile, cts.	4	4	8	5
Motor-Cars (complete).				
First cost, each.	$12,000	$13,500	$20,000	
Weight, tons (2,000 lb.)	43	44	54	
Average efficiency, wheels to trolley, per cent	82	81	73	
Maintenance per car-mile, cents	2	2.2	3.5	

† Other weights of locomotives will cost, more or less, about in proportion to their weights. With gearless direct-current locomotives, the average efficiency of locomotive wheels to trolley is approximately 88 per cent.

"In cases where purchased power is used, or is depended on as a reserve, the frequency of the current supplied by the power company will have a bearing on the cost of sub-stations, and will thus affect the choice of the system. For direct-current operation, rotary apparatus is used for converting the alternating into direct current, and the fre-

quency of the supply is therefore relatively unimportant. For single phase operation under the usual conditions a frequency of not more than 15 cycles is desirable; and to provide this frequency, rotary frequency changers are as necessary as are rotary converters in the case of direct current, since the frequency of existing power companies ranges from 25 to 60 cycles.

"With power supplied at the proper frequency for single-phase operation permitting the use of static transformers and dispensing with frequency changers, the amount of energy required for a given trunk-line service is in many cases nearly the same as for direct current, the greater weight of the equipped rolling stock, and the lower efficiency of the single-phase equipments, off-setting the rotary converters and trolley-line or third-rail losses of the direct current.

"The principal conditions which determine railway equipment are:—

(*a*) Profile of road.

(*b*) Transportation required—*i. e.*, weight of trains or seating capacity of cars.

(*c*) Frequency of trains.

(*d*) Length of individual runs or distance between stops.

(*e*) Schedule required.

(*f*) Length of railway to be electrified.

"In the selection of the electrical system best adapted to a particular set of conditions there are three items to be considered:—(*a*) sub-stations, (*b*) contact conductors, (*c*) rolling-stock. A comparison of these items determines the relative economic values of the systems. There are certain features under each of these items which may properly be examined. For trunk-line service the values in the table will be found within reasonable limits for the usual requirements.

"We will consider briefly the effect of changes in the above items.

(*a*) *Profile.*—From a level country to a limiting grade of 1 or 1½ per cent. there will be little difference in the relative values of the systems. With steeper grades the conditions will be more favourable for alternating current.

(*b*) *Traffic Requirements.*—Heavy individual train-units favour the alternating-current system with exception of the locomotives; light trains or multiple-unit operation favour the direct-current system.

(*c*) *Frequency of Trains.*—Infrequent service with a relatively small number of locomotives favours the alternating current, frequent service the direct current. With increase in number of trains, the direct-current systems gain relatively faster than the alternating current in economy of operation, due to relatively decreased sub-station operation, increased sub-station efficiency, and lower cost of equipment maintenance. It is therefore well to consider what the ultimate traffic density may be, and select the system best suited to meet these requirements.

(*d, e*) *Distance between Stops and Schedule Required.*—Variations in these will not affect the relative value of systems unless extreme requirements, such as high schedule speed with short runs, make the use of direct current imperative.

(*f*) *Length of Road.*—For a similar character of service throughout the railroad may be of any length without affecting the relative desirability of the various systems. What is suitable for the first 50 miles will be equally suitable for any extension.

"An examination of these variables will show that a change in the conditions to be met will radically change the relative economic value of the systems of electrification. The single-phase system, by reason of the apparent simplicity of its elements and the utilisation of higher potential for the contact conductor than is possible with direct current, is admitted very attractive. There is the other side to the question, that it is impossible to build a single-phase commutating motor comparable in first cost and maintenance with a direct-current motor. Over this subject of alternating-current single-phase *v.* direct-current systems there has been a great deal of controversy. It is our opinion that comparative results obtained up to the present time are in favour of direct current.

"Desirable as would be a standard system for all classes of service, we cannot hope to establish such a standard should

it impose an additional expense without adequate return. A summing up of all the elements of each electrical system will generally lead to a definite showing of which system is most desirable to meet specific conditions. For trunk-line service a higher potential than 600 volts will unquestionably be used; 1,200 volts direct current will prove economical in some cases, but a still higher voltage is required to provide economically for the heavier intermittent service. Whether this potential will be 1,800 or 2,400 volts direct current or 11,000 volts alternating current cannot be settled arbitrarily."

In the second part of his paper Mr. Potter deals with interurban railways and examines a typical case in which the conditions are favourable to single-phase operation. Here too he finds the direct-current system superior. "An examination of the elements which enter into the first cost and operation of a system will show at once that as the density of traffic increases there is a rapid gain in the relative advantage of the direct-current over the single-phase system. The saving effected by the 1,200-volt direct-current system is so marked that a great increase in the adoption of this potential for this class of interurban railroading may be anticipated, and, on the other hand, it will not be surprising if the single-phase interurban system is entirely discarded in America, unless some marked improvement is made in the art, and a more economical equipment made available. There is no question regarding the mere movement of trains by any particular system—this may be taken for granted. The study of electrification is really a problem in economic engineering, and not simply a technical problem."

EUROPEAN LOCOMOTIVES FOR VERY HIGH SPEEDS.

A SUMMARY OF THE CHARACTERISTICS OF LOCOMOTIVES FOR RUNNING SPEEDS ABOVE SIXTY-TWO MILES PER HOUR.

M. Courtin—International Railway Congress.

WHEN the International Railway Congress met in Paris in 1910, regulation speeds of 90 kilometres (56 miles) per hour were to be found on comparatively few railways, and speeds higher than this were exceedingly rare. The report on locomotives for very high speeds, presented at the Eighth Session, held at Berne last July, by M. Courtin of the Baden State Railway, shows that speeds of 100 kilometres (62 miles) per hour and even higher occupy much the same position now, in Europe at least, as the speed of 90 kilometres occupied 10 years ago. On ten European railways, exclusively in France and Great Britain, regulation speeds of 100 kilometres per hour are attained in regular service, on several other lines this speed is reached under exceptional conditions, while still other railways possess locomotives capable of attaining this speed, although their full power is never used. We give below a brief summary of the characteristics of European locomotives for speeds exceeding 100 kilometres per hour taken from M. Courtin's report, which is printed in the *Bulletin* of the Congress for June.

"In Europe, speeds of 100 kilometres per hour are only attained in regular working, up to the limit of 129 kilometres (80.2 miles) per hour, on the Eastern, Northern and Orleans Railways of France, and the Caledonian, Great Eastern, Great Western, Lancashire and Yorkshire, Midland, North Eastern, and South Eastern Railways in Great Britain; in addition, speeds of up to 120 kilometres (74.5 miles) per hour are attained in exceptional cases, such as lateness, etc., on the Belgian State Railway, Baden State Railway, the P. L. M., Midi and State Railways in France and the Great Central in Great Britain.

"As regards the locomotives used for attaining these high speeds, by far the most usual arrangement is to have a leading bogie; the different types of the kind used are 2A1, 2B, 2B1, 2B2, 2C and 2C1. On a few railways, we

also find locomotives with only one leading carrying axle, for instance, the 1B locomotives of the Paris-Lyons-Mediterranean Railway and on the Great Western Railway, as well as the 1C1 tank locomotives of the latter railway. This locomotive, and also another 2B1 type, also on the Great Western Railway, are the only tank locomotives reported for speeds exceeding 100 kilometres (62 miles) per hour.

"The bogie trucks or leading carrying axles all have more or less lateral play; the return to the central position is ensured by such well-known means as check springs, swing links, etc. On most railways, the trailing carrying axles also have lateral play; this is only absent in a few cases. On several English railways, the driving axles have also a little lateral play.

"As regards the number of cylinders, two-cylinder and four-cylinder locomotives are represented approximately equally, but among the locomotives most recently built there are more four-cylinder locomotives; locomotives with three cylinders are only used to a limited extent, on two English railways, for the purposes here considered. As regards countries, the two-cylinder locomotive predominates in England, while but few of these locomotives are used on Belgian, German, French and Swedish railways. The opposite is the case with four-cylinder locomotives, which are more common on the railways on the continent of Europe, particularly in France. The two-cylinder locomotives have inside cylinders in the great majority of cases; in only about 10 per cent. of the locomotives reported are the cylinders outside.

"The four-cylinder locomotives have two inside and two outside cylinders, without exception. There are no cases of designs with cylinders placed one over the other, or placed one behind the other and acting on the same cross-head (Vauclain or tandem type). As far as four-cylinder compounds are concerned, the low-pressure cylinders are inside and the high-pressure cylinders outside, in the majority of the locomotives. On the French railways, the rule is that the low-pressure cylinders are inside. The Italian locomotives reported have the two high-pressure cylinders on the left, and the two low-pressure cylinders on the right side of the locomotive, one being inside and the other outside in each case. The three-cylinder locomotives, which are all compounds, have one inside high-pressure cylinder and two outside low-pressure cylinders.

"The two-cylinder locomotives are chiefly non-compounds; especially is this the case with the Swedish and English locomotives of this kind, which are all non-compounds. On the contrary, compounding predominates in the case of four-cylinder locomotives; there are only two varieties which are exceptions. The two varieties which have four cylinders and are non-compounds (Belgian State Railway and Great Western Railway), both use superheated steam.

"Low pressures, of from 10 to 12 atmospheres, are only found in a few cases; medium pressures, of nearly 13 and of 14 atmospheres, are more frequent, particularly in the case of the English locomotives, where 12.7 atmospheres is the rule. The highest pressures, of 15 and 16 atmospheres, are found on nearly all the French and German locomotives, and also on Belgian, Danish, Italian and Hungarian locomotives; but there are only very few instances in the case of English locomotives.

"The older wet-steam principle is the rule; superheated-steam locomotives form the exception. Taking it altogether, only two Belgian, four German, one English and one Swedish superheated-steam locomotives have been reported; several administrations are at present building superheated-steam locomotives for high speeds. The German superheated-steam locomotives are all four-cylinder compounds; all the other superheated-steam locomotives are non-compounds, and have either two cylinders (Belgium and Sweden), or four (Belgium and Great Britain).

"As regards size, boilers having a heating surface of from 150 to 250 square metres (1,614.65 to 2,691.08 square feet), and even more, are by far the more usual. Smaller boilers, of heating sur-

faces down to 100 square metres (1,076.43 square feet), are rare exceptions. The grate area varies considerably; it is evident that this is much influenced by the quality of the fuel; this is shown by the comparatively small grates of the English locomotives, and of some of the Continental locomotives which use English coal. The length of the grate, on the large majority of the locomotives, does not exceed 2.5 metres (8 feet 2 7/16 inches). Grates longer than 3 metres (9 feet 10 inches) are only found in very few cases. When a larger grate is required, the plan generally adopted is to have a wider fire-box, either standing on the frame between the wheels, or also extending beyond them.

"Most of the railways use smooth tubes having an external diameter of 45 to 55 millimetres (1 25/32 to 2 5/32 inches). Wider tubes with ribs inside (Serve tubes) predominate on the French locomotives, and are also used on one Belgian locomotive. The length between tube-plates does not as a rule exceed 5 metres (16 feet 5 inches). Lengths of nearly 6 metres (19 feet 8 inches), or a little more, are used in a few cases. The length of the ribbed tubes varies as a rule between 3.5 and 4.5 metres (between 11 feet 6 inches and 14 feet 9 inches).

"On the four-cylinder locomotives, the connecting rods either all act on the same driving axle (as a rule the first), or those of the inside cylinders act on the first and those of the outside cylinders on the second, the two being connected by coupling rods (de Glehn design). The latter design is used on all French, on some of the Danish, and on one of the English four-cylinder locomotives, while the single-axle drive is found on the Belgian, on the German, on the Italian, on the Hungarian and on one of the English four-cylinder locomotives.

"The weights of the locomotives, in working order, vary much, according to design; the lowest figure is 43,000 kilograms (94,800 pounds), for the 2B two-cylinder locomotive of the French Northern Railway, and the highest is 90,400 kilograms (199,300 pounds), for the 2C1 four-cylinder locomotive of the Midi Railway. The adhesive weights, in the case of locomotives with two driving axles, vary between 28,600 and 39,800 kilograms (between 63,050 and 87,740 pounds) (2B two-cylinder locomotives of the French Northern Railway, and 2B three-cylinder locomotive of the Midland Railway). In the case of locomotives with three driving axles, the lowest adhesive weight is 42,470 kilograms (93,630 pounds) (2C locomotive of the French Northern Railway), and the highest 55,500 kilograms (122,350 pounds) (2C locomotive of the Great Western Railway). Axle-loads, on driving axles, of less than 15,000 kilograms (33,100 pounds) are only found in a very few cases. Most of the locomotives have axle-loads, on driving axles, of 16,000 to 18,000 kilograms (35,270 to 39,680 pounds). Higher axle-loads are to be found on some Belgian, French and English locomotives. The maximum, about 20,000 kilograms (44,100 pounds) in round figures, is found on the 2B locomotive of the Midland Railway.

"The figures for the area of heating surface per unit of weight in working order show much less variation. With very few exceptions, the figures per ton for the chief types lie within the following limits:

2B.....	2.24 to 3.5 sq. m. (24.48 to 38.26 sq. ft.)
2B1.....	2.46 to 3.3 sq. m. (26.88 to 36.07 sq. ft.)
2C.....	2.2 to 3.3 sq. m. (24.05 to 36.07 sq. ft.)
2C1.....	2.77 to 3.1 sq. m. (30.28 to 33.88 sq. ft.)

The maximum in this respect is found on the 2B two-cylinder locomotive of the Great Eastern Railway, namely 4 square metres per ton (43.72 square feet per English ton).

"Appliances for reducing air resistance (wind-cutters) are to be found on locomotives of the Danish, German, French, Italian, Swedish and Hungarian railways. They mostly consist of a conical or wedge-shaped extension at the front of the smoke-box, and of a wedge-shaped cab front."

THE ENGINEERING INDEX

"THE KEYSTONE IN THE ARCH OF APPLIED SCIENCE"

The following pages form a *descriptive* index to the leading and special articles of permanent value published currently in the Transactions of all the important engineering societies of both Europe and America, and in all the leading engineering journals of the world—in the English, French, German, Dutch, Italian, and Spanish languages.

The term *descriptive* is used because the definite purpose of each index note is to indicate clearly the character and purpose of the article or paper described; and with that in view we give the following essential information about every publication:

(1) The title of the article,
(2) The name of its author,
(3) A descriptive abstract,
(4) Its length in words,
(5) Where published,
(6) When published,
(7) *We supply the article itself, if desired.*

☞ The full text of every article described in the Index, together with all its illustrations, can usually be supplied by us.—See the "Explanatory Note" at the end of the Index, where also the full titles of the principal journals indexed are given.

NOTE—The busy engineer will also observe that the Index is conveniently classified into the larger divisions of engineering science, to the end that the reader may quickly turn to what concerns himself and his special branches of work. By this means it is possible, within a few minutes' time each month, to learn promptly of every important article published anywhere in the world, in any language, upon the subjects claiming one's special interest.

DIVISIONS OF THE ENGINEERING INDEX.

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CIVIL ENGINEERING.

BRIDGES.

Abutments.

Concrete Pedestal Bridge Abutments on the New York State Barge Canal. Illustrates and describes a novel type. 800 w. Eng News—Aug. 18, 1910. No. 16429.

Arches.

A Plate Girder Arch Bridge Carrying a Concrete Roadway. Illustrated description of a bridge on the Buffalo grade crossing improvements 1200 w. Eng Rec—Aug. 20, 1910. No. 16445.

An Unusual Bridge Job: Putting a Center Hinge in a Two-Hinged Steel Arch. Brief illustrated description. 500 w. Eng News—Aug. 25, 1910. No. 16631.

A Reinforced-Concrete Arched Roof Over a Part of the Saint Martin Canal, Paris (Converture d'une Partie du Canal Saint-Martin, à Paris, par une Voûte en Béton armé). M. Mesnager. Detailed description of the work. Ills. Serial. 1st part. 5500 w. Génie Civil—July 30, 1910. No. 16552 D.

We supply copies of these articles. See page 148.

Cantilever.

The Main Street Bridge Over the Buffalo Belt Line. Illustrated description of a single-span skew cantilever bridge with protected steel work and a solid concrete floor. 1500 w. Eng Rec—Aug. 27, 1910. No. 16670.

Concrete.

Building a Concrete Railroad Bridge Under Traffic. Brief illustrated description of a bridge in Philadelphia to carry the Philadelphia & Reading Railway over Belfield Ave., and the method of construction. 1000 w. Eng Rec—Aug. 20, 1910. No. 16441.

Foundations

The Substructure of the Dumbarton Point Bridge. Illustrated description of difficult construction work in a recently completed double-track bridge on the Southern Pacific across lower San Francisco Bay. 2500 w. Eng Rec—Aug. 13, 1910. No. 16323.

The Substructure of the American River Bridge. Illustrated description of difficult work in California, carried out by the Southern Pacific Co. 2000 w. Eng Rec—Aug. 27, 1910. No. 16664.

Lift Bridges.

Erection of an Eight-Track Rolling Lift Bridge. Illustrates and describes difficult work in Chicago in replacing old fixed structures by new movable structures, without interrupting railway traffic 2000 w. Eng Rec—Aug. 13, 1910. No. 16332.

Piers.

A Tall Reinforced Concrete Bridge Pier. Illustrated description of a pier 165 ft. high, built in the Willamette River, near Portland, Ore. 1600 w. Eng Rec—Aug. 6, 1910. No. 16219.

Reinforced Concrete.

Three - Hinged Reinforced - Concrete Arch Bridge, Los Angeles. Illustrated detailed description of the design and construction. 2500 w. Eng Rec—Aug. 13, 1910. No. 16327.

Steel.

The Miles Glacier Bridge. Explains conditions that were met in constructing the Copper River & North Western Ry. in Alaska, and describes the bridge and its construction. 2500 w. Eng Rec—Aug. 6, 1910. No. 16217.

The Steel Superstructure of the Baumgarten Bridge near Potsdam (Eiserner Ueberbau der Baumgartenbrücke bei Potsdam). F. Eybächer. Illustrated detailed description. Serial. 1st part. 2500 w. Zeitschr d Ver Deutscher Ing—July 23, 1910. No. 16786 D.

See also Arches, under Bridges.

Viaducts.

Mission Bay Viaduct; Southern Pacific. Illustrations with brief description. 300 w. Ry Age Gaz—Aug. 19, 1910. No. 16461.

CONSTRUCTION.

Bore Holes.

Tests of Bore-Hole Linings (Versuche mit verschiedenen Bohrlochauskleidung). F. v. Emperger. Discusses results of tests of linings consisting of two wrought-iron pipes with the annular space between them filled with cement mortar. Ills. Serial. 1st part. 2500 w. Beton u Eisen—July 2, 1910. No. 16764 F.

Concrete.

Concrete Construction in the Philippines. Monroe Woolley. Illustrates and describes buildings erected, and other uses made of concrete. 1200 w. Cement Age—Aug., 1910. No. 16387.

Concrete Building with Steel Columns in the Lower Stories. Illustrates and describes the construction of a five-story building in Hoboken, N. J., used exclusively for the baking of bread. 2000 w. Eng Rec—July 30, 1910. No. 16661.

Concrete Mixers.

Concrete-Making Machinery. Vere Sussex Hyde. Illustrated descriptions of a number of machines. 2500 w. Surveyor—Aug. 19, 1910. No. 16695 A.

Earth Pressures.

Pressure Resistance and Stability of Earth. Discussion of the paper by J. C. Meem. 5000 w. Pro Am Soc of Civ Engrs—Aug., 1910. No. 16645 F.

Foundations.

Foundations for the Northwestern Railway Terminal Building, Chicago. Maurice Deutsch. Illustrated description of difficult work. 1200 w. Sch of Mines Qr—April, 1910. No. 16476 D.

Artificial Foundations in Austrian Cities (Praktische Erfahrungen über künstliche Fundierungen in verbauten Stadtgebieten Oesterreichs). Richard Kafka. Illustrated description of systems in use. Serial. 1st part. 1500 w. Zeitschr d Oest Ing u Arch Ver—July 22, 1910. No. 16757 D.

Compress Foundations at the New Gas Works in Lausanne (Applications du Système Compressol aux Fondations de la nouvelle Usine à Gaz de la Ville de Lausanne). P. Ossent. Describes foundations for furnaces, stacks, and a water tower. Ills. 1000 w. Bul Tech d l Suisse Romande—July 10, 1910. No. 16533 D.

Gasholders.

Steel Gasholder Tanks with Bulging Sides. Notes translated from a paper by Edouard Bonnet, describing tanks built in Germany. 3000 w. Eng Rec—Aug. 13, 1910. No. 16325.

Grain Elevators.

Reinforced-Concrete Grain Bins for the Storage Annex at Superior, Wis., Great Northern Ry. O. B. Robbins. Illustrates and describes the design and construction of these storage bins. 3000 w. Eng News—Aug. 4, 1910. No. 16171.

A Grain Elevator in Bremen (Getreidesilo in Bremen). E. Lufft. Describes

We supply copies of these articles. See page 158.

an important reinforced-concrete structure. Ills. 1700 w. Beton u Eisen—July 2, 1910. No. 16762 F.

Reclamation.

See Dikes, under WATERWAYS AND HARBORS.

Reinforced Concrete.

Reinforced Concrete. Arthur C. Auden. From a paper read at the Roy. Inst. of Pub. Health Cong. Discusses the system of reinforcement, materials, uses, etc. 3500 w. Surveyor—Aug. 19, 1910. No. 16696 A.

Reinforced Concrete or Steel Construction (Eisenbetonbau oder Eisenbau). A reply to criticisms of concrete construction in an article by Herr Fischmann. 4000 w. Deutsche Bau—July 13, 1910. No. 16596 B.

Reinforced Concrete Work in New Zealand. B. W. Wilson. Illustrates and describes important structures in and about Auckland. 2000 w. Cassier's Mag—Aug., 1910. No. 16286 B.

Methods for the Computation of Reinforced-Concrete Flat Slabs. Louis F. Brayton. A discussion of a paper by Argus B. MacMillan, giving plan of floor slab designed by the writer. 1800 w. Eng News—Aug. 25, 1910. No. 16633.

Calculation of the Statically Indeterminate Frame Members in the New "Alter Teichweg" Refuse-Destructor Plant, Hamburg-Barmbeck (Berechnung des sechsfach statisch unbestimmten Eisenbeton-Hallenbinders der neuen Unrat-Verbrennungsanstalt "Alter Teichweg," Hamburg-Barmbeck). Max Bachner. Mathematical. Ills. 4000 w. Beton u Eisen—July 2, 1910. No. 16761 F.

Compound Bending and Torsion Stresses in Rectangular Beams of Reinforced Concrete (Sollecitazione composta di Flessione e di Torsione nelle Travi rettangulari di Cemento armato). Umberto Puppine. Mathematical discussion. Ills. 4000 w. Monit Tech—July 30, 1910. No. 16566 D.

See also Stairways, and Grain Elevators, under CONSTRUCTION; Tanks, under WATER SUPPLY; and Sea Walls, under WATERWAYS AND HARBORS.

Retaining Walls.

Formulas for the Design of Gravity Retaining Walls. W. H. Rose, in *Prof. Mem.*, Corps of Engrs. Presents easily applied formulae for the use of engineers. 2000 w. Engng-Con—Aug. 10, 1910. No. 16273.

The Theory of Earth Pressure on Retaining Walls (Zur Theorie des Erddruckes auf Stützmauern). Otto Mohr. A criticism of Max Ritter's paper in *Schweizerische Bauzeitung* for April 9, 1910, with a reply by the latter. Ills. 2000 w. Schweiz Bau—July 23, 1910. No. 16598 B.

Roofs.

See Arches, under BRIDGES.

Stairways.

Reinforced Concrete Stairways (Kragkonstruktion aus Eisenbeton bei Unterbauten für Freitreppen). Herr Weidmann. Describes in detail the design of a reinforced-concrete stairway. Ills. 2000 w. Beton u Eisen—July 2, 1910. No. 16763 F.

Steel.

The Erection of the Gimbel Building, New York. Illustrations and description of the fireproof construction of a large building for commercial purposes. 2000 w. Eng Rec—July 30, 1910. No. 16657.

The Doe Memorial Library, University of California. W. L. Huber. Illustrated detailed description of a building costing about $1,000,000. 2500 w. Eng Rec—Aug. 27, 1910. No. 16667.

Structural Steel Details in the Ball Realty Building. Describes the construction of a steel cage office building on Fifth Ave., New York City, and the details made necessary by the condition of the soil and the foundations of an adjacent building. Ills. 2000 w. Eng Rec—Aug. 13, 1910. No. 16330.

See also Reinforced Concrete, under MATERIALS OF CONSTRUCTION.

Swimming Pools.

The Carnegie Swimming Pool at Yale University. C. S. Farnham. Illustrated description. 1000 w. Eng News—Aug. 11, 1910. No. 16311.

Tunnels.

Construction Methods and Organization in Constructing the Buffalo Water Works Tunnel. Illustrates and describes the construction of a rock tunnel under Lake Erie, 6,000 ft. long, and a land tunnel, 4,300 ft. long. 10800 w. Engng-Con—Aug. 17, 1910. Serial. 1st part. No. 16439.

The New York Tunnel Extension of the Pennsylvania Railroad.—The Long Island Approaches to the East River Tunnels. George C. Clarke. Illustrated detailed description of the portion of this work extending from East Ave. to Thomson Ave., in Long Island City, covering a portion on which the line changes from an underground to a surface railroad, and the entrance to the Sunnyside yard. 11500 w. Pro Am Soc of Civ Engrs—Aug., 1910. No. 16642 F.

The New York Tunnel Extension of the Pennsylvania Railroad.—The Sunnyside Yard. Louis H. Barker. Illustrated detailed description of the terminal passenger yard in New York City, located on Long Island. 4000 w. Pro Am Soc of Civ Engrs—Aug., 1910. No. 16643 F.

The New York Tunnel Extension of the Pennsylvania Railroad.—The Lining of the Four Permanent Shafts of the East River Division. F. M. Green. Illustrated description of shafts to promote ventilation, to provide access and

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egress from the tunnels, to permit electric connections, and to provide for pump discharge. 2000 w. Pro Am Soc of Civ Engrs—Aug., 1910. No. 16644 F.

See also Sewers, under MUNICIPAL.

MATERIALS OF CONSTRUCTION.

Brick.

Modern Methods of Brick-Making. Alfred B. Searle. Considers bricks as a building material, their characteristics, and manufacture. Ills. 8000 w. Jour Soc of Arts—Aug. 12, 1910. Serial. 1st part. No. 16480 A.

Cement.

The Effect of Alkali Water on Cement Mortars. A. J. Fisk, Jr. Gives results of tests at the University of Wisconsin. Describes materials and methods and states conclusions. 1500 w. Eng News—Aug. 18, 1910. No. 16426.

The Behavior of Hydraulic Compounds in Sea Water. H. Burchartz. A report of investigations made by order of the Prussian Minister of Public Works, and the results. Ills. 3000 w. Eng Rec—Aug. 27, 1910. No. 16666.

Manufacture and Use of Slag Cement and Other Substitutes for Portland Cement. W. D'Rohan. Describes how substitutes for Portland cement may be made in places where the cost for cement would be prohibitive. Also editorial. 3300 w. Engng-Con—Aug. 24, 1910. No. 16620.

Concrete.

See Dams, under WATER SUPPLY.

Mortars.

Mortar for Masonry Dams (zur Frage des Talsperrenmörtels). Hermann Schmidt. Discusses the characteristics of mortars of various compositions. Ills. 6000 w. Oest Wochenschr f d Oeffent Baudienst—July 30, 1910. No. 16760 D.

Paints.

The Effect of Crystalline Pigments on the Protection of Wood. Henry A. Gardner. A study of paint tests, reporting bad results when the wood is not properly selected. Ills. 1200 w. Jour Fr Inst—Aug. 1910. No. 16378 D.

Reinforced Concrete.

See Corrosion, under ELECTRICAL ENGINEERING, ELECTRO-CHEMISTRY.

Steel.

Tests of Vanadium-Steel Eye-Bars. Brief report of tests made at the Ambridge works of the American Bridge Company. 600 w. Eng Rec—July 30, 1910. No. 16058.

Tests of Nickel Steel Riveted Joints. An account of tests made under the supervision of Prof. A. N. Talbot, for the Board of Engineers, Quebec bridge, giving details and results. Also editorial note. 5000 w. Eng Rec—Aug. 20 1910. No. 16440.

Timber Preservation.

Notes on Wood Preservation and Creosote Production in Europe. E. A. Sterling. A report of recent observations in Europe of preservative methods for the treatment of timber. Discussion. Ills. 7000 w. Pro Engrs' Club of Phila—July, 1910. No. 16394 D.

Preservative Treatment of Farm Timbers. C. P. Willis. Information of value to farmers concerning simple methods of preservation. Ills. 2500 w. Sci Am Sup—Aug. 27, 1910. Serial. 1st part. No. 16659.

Crude Oil Treatment of Ties. E. O. Faulkner. A report of the Bakersfield oil tests, the Ebano oil tests, and tests to determine water absorption immediately after treatment. 4500 w. Ry Age Gaz—Aug. 19, 1910. No. 16460.

Obligatory Timber Preservative Treatment (Ueber den obligatorischen Gebrauch von Holzkonservierungsmitteln im Hochbau). Basilius Malenkovic. An argument for making the preservation treatment of structural timber obligatory in Austria. 3200 w. Oest Wochenschr f d Oeffent Baudienst—July 16, 1910. No. 16759 D.

MEASUREMENT.

Cement Testing.

German Standard Specifications for Delivery and Testing of Portland and Iron-Portland Cement. Ills. 1500 w. Eng News—Aug. 25, 1910. No. 16635.

Rainfall.

The Determination of Rainfall over a Given Area (Sulla Determinazione delle Massime Pioggie Attribuibili ad una Data Zona). U. Massari. Illustrated description of methods. Serial. 1st part. 1500 w. Monit Tech—July 10, 1910. No. 16562 D.

Stream Gauging.

Measuring the Flow of Large Streams. Franklin Van Winkle. Explains how to obtain the area of the stream and also the velocity of flow by means of surface, sub-surface and rod floats. Ills. 5000 w. Power—Aug. 16, 1910. No. 16375.

Experiments on Small Weirs and Measuring Modules. J. C. Stevens. Illustrated description of experiments with reference to their accuracy and their suitability for every-day gaging work in irrigation canals. 7000 w. Eng News—Aug. 18, 1910. No. 16428.

Stream Flow at Single Cross Section. Franklin Van Winkle. Explains measurement by means of current pressure gages, velocity meters, and float wheels. Ills. 4500 w. Power—Aug. 30, 1910. No. 16736.

Surveying.

Field and Office Methods in a Triangulation and Plane-Table Survey of the Ducktown Copper Mining District. Benjamin H. Case. Describes the methods used in making the survey and map. Ills. 3000 w. Eng News—Aug. 18, 1910. No. 16427.

We supply copies of these articles. See page 158.

Photographic Surveying from Balloons (La Fotografia dall' Aerostato nelle sue Applicazioni Topografia). Cap. Tardivo. A complete description of the methods employed and of the possibilities. 5000 w. Ann d Soc d Ing e d Arch Ital—July 1, 1910. No. 16558 F.

MUNICIPAL.

Efficiency System.

Civil Service Efficiency System, Chicago. Describes the system to be applied. 2800 w. Eng Rec—Aug. 20, 1910. No. 16442.

Pavements.

Concrete Pavement Construction at Boise, Idaho. Describes methods and gives cost. 1100 w. Engng-Con—Aug. 24, 1910. No. 16621.

Some Costs of Street Paving Work at Baltimore, Md. Information from the annual report for 1909. 2500 w. Engng-Con—Aug. 10, 1910. No. 16274.

Testing Paving Stone with the Sand-Blast Machine (Beproeving van Straatsteenen met de Zandblaas-machine). M. E. H. Tjaden. Discusses the utility of the test and illustrates results. 4000 w. De Ingenieur—July 16, 1910. No. 16795 D.

Refuse Disposal.

Town Scavenging and Refuse Disposal. Hugh S. Watson. Discusses the utilization of residuals from refuse destructors. 1500 w. Munic Engng—Aug., 1910. No. 16390 C.

Disposal of City Refuse. Outlines the general methods adopted in Canada, illustrating an incinerating plant at Westmount. 5000 w. Can Engr—Aug. 25, 1910. No. 16689.

The Operation of the Seattle Refuse Destructor. Shows graphically the results obtained and gives information concerning the factors governing the operation. 1800 w. Eng Rec—Aug. 13, 1910. No. 16326.

Specifications for Determining Cost of Garbage Incineration. Gives specifications issued by the San Francisco Board of Public Works relating to tests and cost. Ills. 3500 w. Engng-Con—Aug. 24, 1910. No. 16622.

Disposal Methods for Manufactural Wastes. A review of various methods of trade wastes disposal taken from an article by Robert Spurr Weston, in *Cotton*. 3000 w. Eng Rec—Aug. 27, 1910. No. 16665.

Roads.

Dust Prevention on Public Roads. Reviews methods that have been tried. 1200 w. Sci Am—Aug. 27, 1910. Serial. 1st part. No. 16656.

Supplementary Reports on the 1907 and 1908 Dust Prevention and Road Preservation Experimental Work of the U. S. Office of Public Roads. Also experimental work in 1909. 13000 w. Engng-Con—Aug. 3, 1910. No. 16167.

Bituminous Roads—Mixed and Poured. George C. Warren. Paper for the Int. Road Cong., at Brussels. Presents the advantages and disadvantages of the pouring and penetration methods, and of the mixing methods. 2200 w. Engng-Con—Aug. 10, 1910. No. 16275.

The Use of Tar on Roads. A. D. Whittaker. Read before the So. Gas Assn. Information concerning the use of tar, giving experience at several places and explaining methods. Ills. 7000 w. Am Gas Lgt Jour—Aug. 29, 1910. No. 16688.

Petrolithic and Other Systems of Road and Street Improvements at El Paso, Tex. Extracts from a report by F. H. Todd, including statements regarding "petrolithic and oiled macadam." 1200 w. Eng News—Aug. 4, 1910. No. 16170.

Sanitation.

The Relation of Water Supply to Sewerage and Sanitation. Richard Read. Read before the Inst. of Munic. & Co. Engrs. Discusses the subject of waste and means of relieving water-works by arranging for obtaining water for flushing purposes and street watering from other sources. Discussion. 3500 w. Surveyor—July 22, 1910. No. 16134 A.

Rat Suppression for Plague Prevention in San Francisco, Cal. G. M. Converse. Report to the U. S. Pub. Health and Marine-Hospital Service. Also editorial. 2500 w. Eng News—Aug. 25, 1910. No. 16627.

Sewage Disposal.

Sewage Disposal of Seaside and Tidal Towns. A. J. Price. A detailed discussion of the conditions and requirements, suggesting remedies and methods of disposal. General discussion. Ills. 10000 w. Surveyor—Aug. 5, 1910. No. 16347 A.

A Series of Notable Reports on Sewage Disposal by Dilution at Rochester, N. Y. Also editorial. 11000 w. Eng News—Aug. 11, 1910. No. 16316.

Creek Improvement at Syracuse. Illustrated account of preliminary investigations, explaining the conditions, and describing novel features in plans and specifications. 2500 w. Munc Jour & Engr—Aug. 10, 1910. No. 16271.

The Sewage Disposal Works of Mount Vernon, N. Y. Plans and description of a system providing for the use of a screening chamber, settling tanks, sprinkling filters and secondary settling basins. 3500 w. Eng Rec—Aug. 20, 1910. No. 16446.

Sewage Disposal Works, North Attleborough, Mass. Illustrated description of works comprising two double hopper-bottom settling tanks and sixteen intermittent sand filters. 2500 w. Eng Rec—Aug. 27, 1910. No. 16669.

Operation of the Reading Sewage Purification Works. E. Sherman Chase. Gives detailed results of operation of the new

sewage works which are of interest to those connected with similar work. 3300 w. Eng Rec—Aug. 13, 1910. No. 16329.

Sewage Disposal in the Vicinity of London, England. H. N. Ogden. Discusses points observed in a recent visit to about a dozen plants near London, and their application to American conditions. 3500 w. Eng Rec—Aug. 6, 1910. No. 16215.

Sewage Disposal Works at Bushey. Ernest E. Ryder. Illustrated description of works and treatment. 1500 w. Surveyor—Aug. 5, 1910. No. 16345 A.

Sewer Gauging.

Gauging Sewage Flow on New Jersey "Joint Outlet" Sewer. Describes the gauges used and the gauge chambers. Ills. 1000 w. Munic Jour & Engr—Aug. 24, 1910. No. 16646.

Sewers.

The Fourteenth Street Sewer Tunnel, Washington, D. C. Asa E. Phillips. Explains conditions which practically precluded open-cut work, and describes the method of doing the work in tunnel with two shafts. Ills. 1000 w. Eng Rec—Aug. 6, 1910. No. 16221.

Some Structural Details of the River Des Pere's Foul Water Sewer at St. Louis, Mo. Ills. 1400 w. Engng-Con—Aug. 3, 1910. No. 16168.

Street Cleaning.

Street Cleansing and Watering. F. H. Yabbicom. Compares methods that have been adopted in some of the large towns of England, Scotland and Ireland. 6000 w. Surveyor—Aug. 5, 1910. No. 16346 A.

WATER SUPPLY.

Analysis.

Field Assay of Water. R. B. Dole. Aims to show the uses and limitations of these methods. 3000 w. Eng News—Aug. 11, 1910. No. 16312.

Aqueducts.

Carrying Water Through a Desert. Burt A. Heinly. A finely illustrated account of the construction of the Los Angeles aqueduct. 6500 w. Nat Geog Mag—July, 1910. No. 16043 C.

Electric Power in the Construction of the Los Angeles Aqueduct. E. F. Scattergood. Outlines this great work, and gives illustrated description of the arrangements for supplying power for construction purposes, and its uses. 3300 w. Pro Am Inst of Elec Engrs—Aug., 1910. No. 16399 F.

Dams.

Cracks in Concrete Core-Wall of the Little Bear Valley Dam, California. Sections and description of cracks, believed to be temperature cracks. 1200 w. Eng News—Aug. 25, 1910. No. 16632.

St. Andrews Rapids Dam. H. P. Borden. Map, showing location, with illustrated description of a dam of the type known as a "Caméré curtain dam," the first to be constructed on the American Continent. 3000 w. Engr, Lond—Aug. 12, 1910. Serial. 1st part. No. 16604 A.

Stoney-Gate Dam in the Albula Canyon for the Hydro-Electric Power Plant of the City of Zurich, Switzerland. K. E. Hilgard. Illustrated detailed description of a dam with three openings closed by gates of the Stoney type. 1500 w. Eng News—Aug. 25, 1910. No. 16636.

Ireland.

The Water Supply of Smaller Towns in Ireland. J. H. H. Swiney. Read before the Roy. San. Inst. Discusses the quantity required, the sources of supply, and the main considerations of importance. 2000 w. Surveyor—July 22, 1910. No. 16135 A.

Irrigation.

The Rio Grande Irrigation Project. Newton Forest. Illustrated description of interesting features, including one of the largest reservoirs in the world. 2000 w. Sci Am Sup—Aug. 13, 1910. No. 16284.

The Region in Roumania Inundated by the Danube (La Région d'Inondation du Danube en Roumanie). L. Mrazek. Describes a system of irrigation similar to that of the Nile. 5500 w. Rev Gen d Sci—July 30, 1910. No. 16531 D.

Irrigation in the Agro Romano (Per l'Irrigazione dell Agro Romano). G. de Angelis d'Ossat. A plea for the application of irrigation to this section of Italy. 5200 w. Ann d Soc d Ing e d Arch Ital—July 1, 1910. No. 16557 F.

Pipe Corrosion.

Poor Pipe Causes Red Water in Springfield, Mass. Report of George C. Whipple on an investigation made of the rusty condition of the hot water in numerous apartment houses, and the cause of the trouble. 4000 w. Eng Rec—July 30, 1910. No. 16056.

Pipe-Line Design.

Determination of the Resultant Angle in Laying Out Combined Bends for Pipe Lines. C. A. Jackson. Gives a graphical method and an analytical method, illustrating by example. Ills. 2000 w. Eng News—Aug. 11, 1910. No. 16313.

The Choice of a Formula for the Calculation of Conduits (Sulla Scelta di una Formula per il Calcolo delle Condotte d' Acqua). B. Benigni. A comparison of the various formulae. 2800 w. Ann d Soc d Ing e d Arch Ital—July 15, 1910. No. 16561 F.

Pipe Specifications.

Canadian Soc. of Civil Engineers' Standard Specifications for Cast Iron Water Pipe and Special Castings with Tables of Dimensions, Thicknesses and Weights as Presented by a Special Committee. Approved by the Council of the Society, June 11, 1910. 8000 w. Can Soc of Civ Engrs—1910. No. 16397 N.

We supply copies of these articles. See page 158.

Plymouth, England.

The Plymouth Water Undertaking. Frank Howarth. Read before the Inst. of Munic. & Co. Engrs. History of one of the oldest municipal water undertakings in England, with illustrated description of present works. Also discussion. 10000 w. Surveyor—July 29, 1910. No. 16241 A.

Purification.

Water Purification by Ozone. Describes briefly methods used in European installations, and a recent installation at Lindsay, Ontario, in accordance with plans by J. Howard Bridge, which eliminates the auxiliary units. 1500 w. Munic Engng—Aug., 1910. No. 16391 C.

Water Purification Plant, Putnam, Conn. Describes conditions and the plant for a town of about 8000 inhabitants. 2500 w. Eng Rec—Aug. 13, 1910. No. 16331.

Reservoirs.

Hill View Reservoir, New York. Illustrated description of the features of design and construction of a reservoir forming a part of the new Catskill supply for New York City. 1500 w. Munic Jour & Engr—Aug. 3, 1910. No. 16161.

Santiago, Cuba.

The Water Supply System of Santiago, Cuba. H. F. Cameron. Illustrated description of the first plant of a national sanitary system in Cuba. 1700 w. Eng Rec—July 30, 1910. No. 16062.

Siphons.

The Albelda Reinforced-Concrete Siphon on the Aragon and Catalonia Canal, Spain (Le Siphon en Béton armé d'Albelda sur le Canal d'Aragon et Catalogne, Espagne). Mariano Luiña. Describes its design and method of construction. Ills. 3300 w. Génie Civil—July 23, 1910. No. 16550 D.

Springs.

Observations on the Permanency of Overflow Springs. Henry Preston. Refers to conditions in England only, describing the springs and explaining their origin. Discussion. 3000 w. Surveyor—July 22, 1910. No. 16136 A.

Sterilization.

The Sterilization of Water by Chlorine and Ozone. G. Sims Woodhead. Read before the Roy. San. Inst. A report of experiments made in connection with the treatment of an English water supply. 3000 w. Surveyor—July 22, 1910. No. 16133 A.

Tanks.

A Reinforced-Concrete Pumping Cistern Sunk Into Place in the Ground. W. Dewitt Vosbury. Describes work at Haddonfield, N. J., in connection with artesian water-works. Ills. 1500 w. Eng News—Aug. 25, 1910. No. 16630.

The Design of Large Steel Tanks. John E. and Wm. S. B. Irvine. Read before the Glasgow Tech. College Sci. Soc. Considers steel tanks for storing liquids, describing methods of design. 3000 w. Mech Engr—Aug. 19, 1910. No. 16697 A.

The Design of Cylindrical Reservoirs (Le Calcul des Réservoirs circulaires). Henry Lossier. Mathematical exposition of the method of calculation. Ills. 4000 w. Génie Civil—July 30, 1910. No. 16553 D.

Water Works.

Water Supply. Martin Deacon. From a paper before the Roy. Inst. of Pub. Health Cong. Discusses reservoirs, dams, embankments, filters, wells, etc. 2500 w. Surveyor—Aug. 12, 1910. No. 16495 A.

The Water-Works of Monterey, Mexico. Illustrated detailed description of recently completed works. 3000 w. Eng Rec—Aug. 6, 1910. No. 16220.

Water-Works Valuation.

The Appleton Water-Works Decision. A report of the valuation controversy in Wisconsin. 3500 w. Eng Rec—Aug. 6, 1910. No. 16218.

Wharves.

Wharf Construction at Fort Mason, California. Illustrated detailed description of the construction methods used in building wharves for the quartermaster's department of the U. S. Army on San Francisco Bay. 4000 w. Eng Rec—Aug. 6, 1910. No. 16214.

WATERWAYS AND HARBORS.

Barge Canal.

See also Locks, under WATERWAYS AND HARBORS.

Canal Gates.

Emergency Gates on the Illinois and Mississippi Canal. Describes these gates and their operation. 2000 w. Eng Rec—Aug. 20, 1910. No. 16443.

Canals.

The Tieton Canal. E. G. Hopson. Describes the main canal or aqueduct along the Tieton Canon, in the State of Washington, several novel features of design and construction having been adopted. Ills. 9500 w. Pro Am Soc of Civ Engrs—Aug., 1910. No. 16640 F.

Project for a Ship Canal Between the Tyne and Solway Firth. J. Watt Sandeman. Briefly reviews various schemes considered and describes in detail the project named, discussing its advantages. 4500 w. Trans N-E Coast Inst of Engrs & Shipbldrs—July, 1910. No. 16392 N.

The Manchester Ship Canal. H. G. Moulton. Extracts from the *Jour. of Political Economy*. Reviews briefly the story of its construction, and discusses its economic aspects. 5000 w. Ry & Engng Rev—Aug. 13, 1910. No. 16372.

Constantza.

The Harbor of Constantza. Dr. Alfred Gradenwitz. Illustrated description of an artificial harbor basin constructed in Roumania. 3500 w. Sci Am Sup—Aug. 20, 1910. No. 16432.

We supply copies of these articles. See page 158.

Dikes.

Dike at Herring River, Wellfleet, Mass. Mosquito Extermination Work. Frank W. Hodgdon. Illustrated detailed description of a dike built on Cape Cod to abolish mosquitoes by drainage of the marshes, and also reclaiming a large area of fertile land. 1200 w. Eng News—Aug. 11, 1910. No. 16315.

Floods.

Report of the Flood on the Zuni River, Sept. 6, 1909. H. F. Robinson. An account of the flood in New Mexico which caused the failure of the Zuni dam. 1200 w. Eng News—Aug. 25, 1910. No. 16629.

Germany.

The Opening of the Bodensee and the Making of the Upper Rhine Navigable Between Constance and Basel (De Ontsluiting van de Bodensee en het Bevaarbaar Maken van den Boven-Rijn tusschen Konstanz en Basel). R. P. J. Tutein Nolthenius. A technical and economic discussion. Ills. 6000 w. De Ingenieur —July 23, 1910. No. 16796 D.

Great Britain.

The Harbors of Great Britain, with Some Reference to Those of North Europe and North America. J. V. Nimmo. A memorandum prepared for the Sociological Soc. of Gt. Britain. 5500 w. Eng News—Aug. 11, 1910. No. 16310.

Locks.

The Siphon Lock at Oswego. Illustrated detailed description. 2500 w. Barge Canal Bul—July, 1910. No. 16272 N.

The Siphon Lock on the Barge Canal at Oswego. Illustrates and describes the first siphon lock to be built in the United States, and said to be the largest ever constructed on the siphon principle. 2000 w. Eng Rec—July 30, 1910. No. 16059.

Panama Canal.

Machinery and Equipment on the Panama Canal Works. This first article illustrates and describes steam shovels, drills, and air compressors. 2500 w. Engr, Lond—Aug. 12, 1910. Serial. 1st part. No. 16603 A.

River Regulation.

Prejudicial Effects of River Regulation in Inhabited Regions (Su certi dannosi Effetti che puo Produrre la Sistemazione dei Fiumi Attraverso gli Abitati). P. Alibrandi. Discusses the possible effect of changing the subterranean water level, with special reference to the Tibur. 3600 w. Ann d Soc d Ing e d Arch Ital—June 15, 1910. No. 16559 F.

Stream Regimen and Dam Construction in the Eastern Alps (Flussregime und Talsperrenbau in den Ostalpen). Discussion of M. Singer's paper printed in this journal for Dec. 10, 1909 et seq. Serial. 1st part. 8000 w. Zeitschr d Oest Ing u Arch Ver—July 1, 1910. No. 16756 D.

The Navigable Rivers of Krain and Their Regulation (Die schiffbaren Flüsse in Krain und ihre Regulierung). Karl Pick. Discusses the possibility of improving the navigable waterways of this part of Austria. Ills. Serial. 1st part. 4000 w. Oest Wochenschr f d Oeffent Baudienst—July 16, 1910. No. 16758 D.

Sea Walls.

Reinforced Concrete Sea Wall Construction of Separately Molded Members. From information furnished by W. E. Adams, London. Describes the new trestle wall system being carried out at Miller's Point. Ills. 3000 w. Engng-Con—Aug. 24, 1910. No. 16619.

Water Powers.

Conservation of Water Powers. Lewis B. Stillwell. Presidential address discussing the practical bearing and effect of existing laws governing the appropriation of water powers located on public lands. 6000 w. Pro Am Inst of Elec Engrs—Aug., 1910. No. 16398 F.

ELECTRICAL ENGINEERING.

COMMUNICATION.

Radiotelegraphy.

New Form of Aerials for Wireless Telegraphy. F. Kiebitz, in *Ann. der Physik*. Considers the influence of the form and disposition of the aerial upon sending and receiving distance. 1200 w. Sci Am Sup—Aug. 27, 1910. No. 16658.

Use of Hot-Wire Ammeters in the Aerial of Wireless Telegraph Stations. John S. Stone. Explains the interpretation of its readings. 600 w. Elec Rev, N Y—Aug. 20, 1910. No. 16459.

See also Thermo-Junctions, under MEASUREMENT.

Telegraph Instruments.

Telegraph Instruments for Rapid Working (Les Appareils Telégraphiques rapides). M. Devaux-Charbonnel. Describes the Pollac-Virag, Baudot, and other apparatus. Ills. 5500 w. Tech Mod (Sup.)—July, 1910. No. 16526 D.

Telegraph Lines.

The Influence of High-Tension Currents on Telegraph and Telephone Installations. Abstract translation from *L'Indus. Elec.* Brief account of remedies adopted to do away with the troubles, giving a summary of new rules of the Prussian State R. R. Dept. on the building of high-tension lines. 1200 w. Elec Rev, N Y—July 30, 1910. No. 16087.

Telegraph Printers.

A Hughes Printing Telegraph of Large

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Capacity (Appareil Hughes à grand Rendement). J. Pierart. Describes a Belgian modification of the Hughes system exhibited at Brussels. Ills. 2700 w. Soc Belge d'Elecns—June, 1910. No. 16502 E.

Telegraphy.

Telegraph Systems: 1907. A compilation of statistics and general information concerning the telegraph industry. Ills. 22500 w. Bureau of the Census—Bul. 102. No. 16156 N.

Telephone Exchanges.

New Post Office Telephone Exchange at Glasgow. Illustrated detailed description. 700 w. Elect'n, Lond—Aug. 19, 1910. Serial. 1st part. No. 16707 A.

Telephone Lines.

See Telegraph Lines, under COMMUNICATION.

Telephony.

Some Notes on a Trip to the North American Continent. W. A. J. O'Meara. An account of telegraph and telephone installations visited in the United States, comparing with English practice. 2000 w. Elect'n, Lond—July 22, 1910. No. 16131 A.

Telephotography.

The Telegraphy of Photographs, Wireless and by Wire. T. Thorne Baker. Discourse at the Roy. Inst. Describes systems used, the apparatus and methods. Ills. 6500 w. Nature—Aug. 18, 1910. No. 16691 A.

DYNAMOS AND MOTORS.

A. C. Dynamos.

Paralleling Alternators. Diagrams and explanation of the precise method of procedure. 2500 w. Engr, Lond—Aug. 5, 1910. Serial. 1st part. No. 16360 A.

Recent Arrangements for the Parallel Running of Electric Machines. W. Wolf. Abstracted from *Elektrotechnik und Maschinenbau*. Deals with the methods employed by the leading firms on the Continent, both for the parallel running and synchronizing of electric machines. Diagrams. 2200 w. Elect'n, Lond—July 29, 1910. No. 16236 A.

A. C. Motors.

The Cascade Motor. Mr. Williams-Ellis. Read before the Assn. of Min. Elec. Engrs., at Nottingham. Illustrated description, explaining the principle and development of this machine. 5500 w. Ir & Coal Trds Rev—Aug. 5, 1910. No. 16365 A.

Polyphase Commutator Machines. J. Jonas. Abstract from *Electrotechnische Zeit*. Discusses the necessity for and possibility of a polyphase motor with economical speed regulation. Describes the polyphase commutator motor and its applications. 2000 w. Elect'n, Lond—Aug. 12, 1910. No. 16491 A.

Constant-Speed A. C. Commutator Motors (Wechselstrom-Kommutatormotoren für praktisch konstante Tourenzahl). F. Niethammer. Brief description of a number of leading types. Ills. 1200 w. Elektrotech u Maschinenbau—July 3, 1910. No. 16773 D.

A. C. Turbogenerators.

Short-Circuit Effects and the Construction of Turbogenerators (Kurzschlusswirkungen und Aufbau von Turbogeneratoren). F. Niethammer. An extension of the author's paper in *Elektrische Kraftbetriebe und Bahnen* for December 14, 1910. Ills. Serial. 1st part. 3500 w. Elek Kraft u Bahnen—July 4, 1910. No. 16767 D.

Armatures.

Faulty Armatures. W. H. F. Murdoch. Explains how to locate the faults and their causes. 700 w. Elec Rev, Lond—July 29, 1910. No. 16233 A.

Commutation.

Commutation Phenomena and Magnetic Oscillations Occurring in Direct-Current Machines. G. W. .Worrall. Abstract of paper and discussion before the Birmingham Sec. of the Inst. of Elec. Engrs. describing experimental investigations. 8500 w. Elec Rev, Lond—July 29. 1910. No. 16234 A.

D. C. Motors.

Shunt Regulating Resistances for Shunt-Wound Motors (Ueber Nebenschluss-Regulier-Widerstände für Nebenschluss-Motore). Carl Gruber. Mathematical. Ills. Serial. 1st part. 1200 w. Elektrotech Rundschau—July 7, 1910. No. 16765 D.

Foundations.

Foundations for Electrical Machinery. Bruce Page. Discusses the requirements of such foundations. Ills. 1500 w. Elec Wld—Aug. 4, 1910. No. 16190.

Friction Losses.

Friction Losses of a Dynamo. A discussion of brush and journal friction, with curves giving the friction loss in each case. 2000 w. Power—Aug. 2, 1910. No. 16072.

Induction Motors.

The Hopkinson Test Applied to Induction Motors. George H. Fletcher. Describes a method of testing induction motors of comparatively large sizes. 900 w. Elec Rev, Lond—Aug. 5, 1910. No. 16340 A.

Installing Induction Motors. R. H. Fenkhausen. Discusses size and arrangement of connecting wires, power factors, overload protection, protection of live parts, and location of motors. Ills. 2500 w. Power—Aug. 23, 1910. Serial. 1st part. No. 16472.

Railway Motors.

The Electric Motor with Variable Speed on the "B. V. D." System. Paul Bary. Explains the characteristics of this system, and reports experiments with a traction motor. Ills. 4500 w. Tram & Ry Wld—Aug. 4, 1910. No. 16488 B.

Rheostats.

Design of Drum Rheostats. L. W.

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Rosenthal. Describes an acceptable form, giving tables of winding characteristics and wire constants. 900 w. Elec Wld—Aug. 18, 1910. No. 16423.

Windings.

Analysis of Leakage Reactance. J. Rezelman. Investigations of the leakage of the windings of a. c. machines. Mathematical. 2000 w. Elect'n, Lond—July 22, 1910. Serial. 1st part. No. 16132 A.

ELECTRO-CHEMISTRY.

Corrosion.

Corrosion of Iron Embedded in Concrete. Guy F. Shaffer. Report of recent tests carried out to obtain data on the effect of currents of low potential on imbedded steel. Ills. 1600 w. Eng Rec—July 30, 1910. No. 16063.

Some Theories and Notes on the Corrosion of Copper and Brass. W. B. Tardy. A résumé of a paper by E. L. Rhead, and the discussion thereon, before the Inst. of Metals. 2000 w. Jour Am Soc of Nav Engrs—Aug., 1910. No. 16797 H.

Electric Furnaces.

Elementary Principles of the Designing and Proportioning of Electrical Furnaces. Carl Hering. Aims to summarize the principles involved in furnace design as far as the proportions are concerned, and to describe the proper sequence in making the calculations. 3000 w. Met & Chem Engng—Aug., 1910. No. 16116 C.

Electroplating.

A Simple Method of Making a Bronze Plating Solution. Describes a solution of copper and zinc for electroplating steel and iron goods. 3000 w. Brass Wld—Aug., 1910. No. 16404.

Nitrogen.

Dr. Schönherr's Process for Producing Atmospheric Nitrates. Brief description of this method for forming nitrogenous products by the electric arc, soon to be applied on a large scale in Norway. 1500 w. Elect'n, Lond—Aug. 5, 1910. No. 16342 A.

Present Status of the Nitrogen Problem (Lo Stato attuale del Problema dell' Azoto). Mario Lombardi. A review of recent developments in the fixation of atmospheric nitrogen. 5000 w. Monit Tech—July 10, 1910. No. 16563 D.

ELECTRO-PHYSICS.

Coherers.

Coherers. W. H. Eccles. Read before the Phys. Soc. Develops a method of investigating detectors, and gives results of experiments on coherers made of oxidized iron wire dipped into mercury, and on coherers made of a clean iron point touching an oxidized iron plate. 2500 w. Elect'n, Lond—Aug. 12, 1910. Serial. 1st part. No. 16489 A.

Impedance.

An Impedance Paradox. F. M. Denton. Gives diagram and explanation. 500 w. Elec Wld—Aug. 11, 1910. No. 16308.

Magnetism.

Contact Difference of Potential in a Magnetic Field. E. P. Adams. Discusses the theory and describes experiments. 1200 w. Elect'n, Lond—Aug. 12, 1910. No. 16492 A.

GENERATING STATIONS.

Accumulators.

Storage Batteries in Isolated Plants. Norman G. Meade. How to find the size of battery required, and discussing rheostat and end-cell regulations. Ills. 2000 w. Power—Aug. 9, 1910. No. 16262.

Storage Batteries in Central Stations. R. Werkner. Discusses the relation of storage batteries to the different systems of generation and distribution. 2200 w. Elec Engr, Lond—Aug. 19, 1910. No. 16702 A.

Installation of Large Battery and Boosters at Dickinson Street Electricity Works, Manchester. S. L. Pearce. Illustrates and describes the general details of the large Tudor battery and automatic reversible boosters. 1500 w. Elec Rev, Lond—July 22, 1910. No. 16126 A.

The Génard "Phœnix" Accumulator (L'Accumulateur "Phœnix," Système F. A. Génard). J. A. Montpellier. Illustrated description. 1800 w. L'Elecn—July 2, 1910. No. 16537 D.

Determination of the Size and Effect of Buffer Batteries (Zur Vorausbestimmung der Grösse und Wirkung von Pufferbatterien). K. Zickler. Describes a method of predetermining the proper size and action of a battery to operate in parallel with a generator. Ills. 4500 w. Elektrotech u Maschinenbau—July 10, 1910. No. 16774 D.

See also Electric, under MECHANICAL ENGINEERING, AUTOMOBILES.

Austria.

Statistics of Central Stations in Austria (Statistik der Elektrizitätswerke in Oesterreich). A brief summary with a supplement giving details of the 675 in Austria on July 1, 1910. 14000 w. Elektrotech u Machinenbau—July 31, 1910. No. 16778 F.

Central Stations.

New Power Stations at Scranton, Penn. F. W. Brady and C. J. Mason. Illustrated description of a 1000 k. w. plant supplying d. c. for street railway service. Uses culm for fuel. 2000 w. Power—Aug. 30, 1910. No. 16732.

Electric Plant at Messina, Italy. Illustrated description of the station which survived the earthquake of 1908, the effect of the earthquake and repairs. 1500 w. Elec Wld—Aug. 11, 1910. No. 16306.

The Extension of the Värta Steam Station of the Stockholm Electrical System in 1909 (Die Erweiterung des Värta-Dampfkraftwerkes der Elektrizitätswerke

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der Stadt Stockholm im Jahre 1909). E. Andreason. Describes the new equipment. Ills. 2000 w. Elek Kraft u Bahnen—July 24, 1910. No. 16771 D.

Economics.

Diversity Factor. H. B. Gear. Analytical study, with deductions. 3000 w. Pro Am Inst of Elec Engrs—Aug., 1910. No. 16400 F.

Motors on Hire. E. P. Austin. Explains this scheme for developing a power load. 2000 w. Elec Rev, Lond—Aug. 19, 1910. No. 16705 A.

Hydro-Electric.

A General Review of Hydro-electric Engineering Practice. Frank Koester. Sixth and concluding article of a series, discussing the financial aspects of power enterprises. Ills. 3000 w. Engineering Magazine—Sept., 1910. No. 16739 B.

The Boulder Hydroelectric Plant. Illustrates and describes the hydraulic work in connection with the plant at Boulder, Colo. 2800 w. Eng Rec—July 30, 1910. No. 16055.

The Arizona Power Company. R. S. Masson. Illustrated description of hydroelectric development, including novel intake, concrete flume, tunnels, syphons and concrete pipe line. Editorial note. 4400 w. Elec Wld—Aug. 18, 1910. No. 16422.

Hydro-Electric Development of the Arizona Power Company. R. S. Masson. Illustrated description of a development obtaining the supply of water from Fossil Springs. 4000 w. Eng Rec—Aug. 20, 1910. No. 16444.

A Michigan Hydroelectric Development. Brief illustrated description of a water power plant of unusual design for Sturgis, Mich. 600 w. Elec Wld—Aug. 25, 1910. No. 16617.

The Wood Pulp and Paper Mills of the Anglo-Newfoundland Development Co. Illustrated description of a large hydro-electric scheme, with the object of providing cheaper paper for London newspapers. 2000 w. Elect'n, Lond—July 29, 1910. Serial. 1st part. No. 16238 A.

Electric Power in and Around Cobalt. Describes the Nipissing Central Railway, the hydroelectric development of the Cobalt Hydraulic Company, an hydraulic compound air plant, and the hydroelectric development of the Cobalt Power Company. Ills. 2500 w. Can Elec News—Sept., 1910. Serial. 1st part. No. 16690 C.

The Kinlochleven Hydroelectric Power Plant. Illustrated description of a modern works in Scotland for the manufacture of aluminum. 2000 w. Elec Rev, N Y—Aug. 27, 1910. No. 16678.

Hydroelectric Development of the Michoacan Power Company. Irwin C. McBride. Illustrated detailed description of power development in Mexico, on the Rio Angulo. 2200 w. Eng Rec—Aug. 27, 1910. No. 16662.

The Rio de Janeiro Electrical Installations (Les Installations électriques de Rio-de-Janeiro). M. Mangin. Describes the generating station and transmission system. Ills. 11500 w. Bul Soc Int d Elecns—July, 1910. No. 16512 F.

The Hydroelectric Plant on the Jhelum River, Kaschmir, British East Indies (Die Wasserkraftanlage am Jhelumfluss in Kaschmir, Britisch Ostindien). Heinrich Homberger. Illustrated detailed description. Serial. 1st part. 1200 w. Zeitschr f d Gesamte Turbinenwesen. July 20, 1910. No. 16750 D.

Water-Power Development on the Drance, at Martigny (Les Forces motrices de la Drance à Martigny). H. Chenaud. Describes a hydro-electric plant on this tributary of the Rhone. Ills. Serial. 1st part. 1500 w. Bul Tech d l Suisse Romande—July 25, 1910. No. 16535 D.

The International Walchensee Competition (Der internationale Walchensee-Wettbewerb). Theodor Koehn. A discussion of the designs submitted for utilizing the waters of the Welchensee for hydro-electric development. Ills. Serial. 1st part. 7000 w. Zeitschr d Ver Deutscher Ing—July 2, 1910. No. 16779 D.

The Economic Utilization of the Water Powers of Baden (Die wirtschaftliche Bedeutung der Wasserkräfte des Badischen Landes). J. Kollmann. Discusses existing developments and future possibilities in this German province. Ills. 7500 w. Tech u Wirt—July, 1910. No. 16793 D.

The Offensee and Schwarzensee Hydro-Electric Plants (Die Elektrizitätswerke Offensee und Schwarzensee). Detailed description of these two new and important Austrian plants. Ills. 6000 w. Elektrotech u Maschinenbau—July 17, 1910. No. 16777 D.

Isolated Plants.

Electrical and Mechanical Installation in the Blackstone Hotel. Illustrated description of the electrical equipment for a Chicago hotel. 3500 w. Elec Rev, N Y—Aug. 20, 1910. No. 16458.

Rates.

The Cost of Electricity. W. D. Marks. An attempt to solve the rate problem on the basis of fixed and variable charges involved in the operation of the plant. Also editorial. 5500 w. Elec Wld—Aug. 4, 1910. No. 16189.

Switchboards.

American Switchboard Practice. Stephen Q. Hayes. Considers the influence of distant-control switchgear on alternating-current station design. Ills. 3000 w. Elec Wld—Aug. 4, 1910. Serial. 1st part. No. 16188.

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LIGHTING.

Incandescent Lamps.

Tungsten Lamp Manufacturing. Newton Harrison. An explanation of the fragility of the tungsten filament and suggestions for the making of an ideal tungsten lamp. 2500 w. Cent Sta—Aug., 1910. No. 16263.

An Improved Method of Sorting Incandescent Lamps. K. Keil. Abstract translation from *Elektrotechnische Zeit.* Gives a graphical solution. 900 w. Elect'n, Lond—July 22, 1910. No. 16129 A.

The Development of the One-Watt-per-Candle Metallic-Filament Lamp in the last two years (Die Entwicklung der Einwatt-Metallfadenlampe in den letzten zwei Jahren). Hartwig v Löti. A review of advances in processes of manufacture. Ills. 3000 w. Elektrotech u Maschinenbau—July 10, 1910. No. 16775 D.

Photometry.

A Portable Phosphorescent Photometer. W. T. Vivian and George W. Huey. An experimental study made at the University of Nebraska aiming to utilize phosphorescent substances as photometric standards of comparison. Editorial note. Ills. 2500 w. Elec Wld—Aug. 18, 1910. No. 16425.

The Hartmann and Braun Portable Apparatus for Testing Incandescent Lamps (Appareil transportable universel pour Mesure des Constantes des Lamps à Incandescence, Système Hartmann et Braun). M. Aliamet. Describes a device combining a photometer, an ammeter, and a voltmeter. Ills. 1500 w. L'Elecn—July 2, 1910. No. 16538 D.

Street.

The Tungsten Lamp as a Factor in Modern Street Lighting. An illustrated discussion showing that the tungsten lamp, with proper auxiliary fixtures, has made it possible to greatly improve street lighting. 2500 w. Elec Jour—Aug., 1910. No. 16383.

MEASUREMENT.

Dynamo Testing.

Retardation Tests of Electrical Machines. F. W. Herlan. Mathematical. 2200 w. Elec Rev, N Y—Aug. 27, 1910. No. 16679.

Electrometers.

The Elementary Theory of the Quadrant Electrometer. R. Beattie. Gives a simple proof of the theory and discusses its sensibility characteristics, and compares them with those of an alternate current moving coil galvanometer. 3000 w. Elect'n, Lond—Aug. 12, 1910. No. 16490 A.

Frequency.

Frequency Meters (Die elektrischen Frequenzmesser). O. Marteinssen. Describes various types. Ills. 2000 w. Elek Kraft u Bahnen—July 11, 1910. No. 16768 D.

Hysteresis.

The Mechanical Measurement of the Work of Hysteresis of Iron in a Rotating Field. G. Vallauri. Reviews the work of other investigators and gives the author's results. 1600 w. Elect'n, Lond—July 22, 1910. No. 16130 A.

Instrument Transformers.

Some Notes on the Use of Instrument Transformers. Kenelm Edgecombe. Discusses errors likely to be introduced by their use, and concludes that with satisfactory design and reasonable precautions the errors are so small as to be negligible in practice. 2300 w. Elec Rev, Lond—July 29, 1910. No. 16232 A.

Laboratory.

Experimental Electrical Circuits for Laboratories. W. P. Steinthal. Read before the Inst. of Elec. Engrs. Illustrated description of recent arrangements for laboratory work in England. 6000 w. Elec Engr, Lond—July 22, 1910. No. 16125 A.

The Work of the Physikalisch-Technische Reichsanstalt in 1909. Details of the electrical work done in the past year. 2500 w. Elect'n, Lond—July 29, 1910. Serial. 1st part. No. 16237 A.

Thermo-Junctions.

On the use of Thermo-Junctions for High-Frequency Current Measurements. C. M. Dowse. Describes a form of thermo-junction suitable for radio-telegraphic measurements in technical colleges. Tests are given showing such junctions are reasonably permanent. 3500 w. Elect'n, Lond—Aug. 19, 1910. No. 16706 A.

Transformer Testing.

The Testing of Transformer Regulation. C. V. Drysdale. Proposes a method in which the voltage of the transformer under test is compared with that of a second transformer of approximately the same ratio on open circuit. 2000 w. Elect'n, Lond—July 29, 1910. No. 16239 A.

POWER APPLICATIONS.

Dock Equipment.

The Electrical Equipment of Smiths Docks, Middlesbrough. Illustrates and describes applications of electricity for power and lighting. 1500 w. Elec Rev, Lond—Aug. 5, 1910. No. 16339 A.

TRANSMISSION.

Cables.

Constants of Cables. Mayo Dyer Hersey. Deduces simple expressions for the resistance, inductance and capacity of eccentric cylinders. 900 w. Elec Wld—Aug. 25, 1910. No. 16618.

Bonding Lead-Covered Cables to Prevent Electrolysis. W. G. Middleton. Discusses good and bad practice, and related subjects. Ills. 4000 w. Elec Rev, N Y—Aug. 27, 1910. No. 16680.

Lightning.

Causes of Lightning. Extract from a

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paper by Dr. J. C. Simpson on experiments on atmospheric electricity. 1500 w. Elec Engr, Lond—Aug. 19, 1910. No. 16703 A.

Line Construction.

Network Conductors (Netzleiter). F. Schauer. Describes details of construction for transmission-line railway crossings. Ills. 2000 w. Elek Kraft u Bahnen—July 14, 1910. No. 16770 D.

Line Design.

Problems in Power Transmission. H. W. Buck. Discusses the advantage of steel towers, length of span, suspension insulators, anchoring the conductors, practical limit of pressure, voltage regulation, etc. 2500 w. Elect'n, Lond—Aug. 19, 1910. No. 16708 A.

Copper Economics in Electrical Distribution. W. H. Myers. Discusses the relative values of different methods of distribution as regards the total weight of conductor and the factors determining the size used. 2500 w. Aust Min Stand—June 15, 1910. Serial. 1st part. No. 16117 B.

Lines.

Electricity for Factories at Kokomo, Ind. Illustrated description of the electrical distribution system of a company which supplies energy for traction, light and power purposes. 2500 w. Elec Wld—Aug. 4, 1910. No. 16187.

See also Hydro-Electric, under GENERATING STATIONS.

Poles.

The Design of Poles (Berechnung von Ueberführungsmasten). Otto Rieger. Describes a method of calculating the necessary size of transmission-line poles of either wood or iron and also the depth to which they must be buried. Ills. 3000 w. Elektrotech u Maschinenbau—July 17, 1910. No. 16776 D.

Regulations.

The French Laws Governing the Distribution of Electricity (Apropos des Règlements administratifs concernant les Distributions d'Energie électrique). M. Brunswick. A report of a committee appointed to consider certain features of the regulations. Ills. 26000 w. Bul Soc Int d Elecns—July, 1910. No. 16511 F.

Transformers.

Transformer Characteristics. K. Faye-Hensen. Describes test methods used to determine the voltage drop of transformers having poor regulation. The results show a considerable change in the local magnetic leakage impedance of certain transformers. Editorial note. 2500 w. Elec Wld—Aug. 18, 1910. No. 16424.

Some Interesting Features in the Design and Application of Transformers. E. G. Reed. Discusses transformer types, showing that large low-voltage units should be built shell type and small high-voltage transformers core type; each class having its own field. 2500 w. Elec Jour—Aug., 1910. No. 16386.

Recent Improvements in Distributing Transformers and Their Relation to Methods of Distribution. J. Frank Martin. Claims that their use as outlined will reduce the investment and increase the efficiency. 1600 w. Elec Rev. N Y—Aug. 6, 1910. No. 16207.

The Stigler-de Faria Static Converters (Convertisseurs statiques, Système Stigler-de Faria). M. de Kermond. Detailed description. Ills. 2000 w. L'Elecn—July 23, 1910. No. 16541 D.

MISCELLANY.

Accidents.

Accidents Due to Excess Voltages and Short Circuits in Electrical Plants and Transmission Lines (Premiers Resultats de l'Enquête sur les Accidents dus aux Surtensions et aux Courts-Circuits dans les Usines et les Reseaux). M. Legouez. First report of a committee investigating electrical accidents. Ills. 7000 w. Bul Soc Int d Elecns—July, 1910. No. 16513 F.

Agriculture.

Electricity in Agriculture (La Force motrice électrique en Agriculture). M. Henry. Abstracted from publications of the A. E. G. 1800 w. L'Elecn—July 2, 1910. No. 16539 D.

Electric Clocks.

Electric Clocks. Illustrates and describes a balance wheel electric clock, and a pendulum electric clock invented by Mr. Murday. 1600 w. Sci Am—Aug. 20, 1910. No. 16431.

INDUSTRIAL ECONOMY.

Accountants' Organization.

Organization—Its Objects and Their Attainment. George Edwards. Discusses the usefulness of organization to accountants in Canada. 4000 w. Jour of Acc—Aug., 1910. No. 16380 C.

Apprenticeship.

Apprenticeship and Industrial Education (L'Apprentissage et l'Enseignement professionnel). Maurice Bellom. A discussion of industrial conditions in France. 4300 w. Génie Civil—July 9, 1910. No. 16547 D.

British East Africa.

Notes on Engineering Matters in British East Africa. E. Keith Abbott. An account of difficulties encountered and overcome in a new country. 2200 w. Jour S African Assn of Engrs—July, 1910. No. 16661 F.

We supply copies of these articles. See page 158.

Education.

Study of Materials as a Subject in a Course in Chemical Engineering. Abstract of the presidential address of Dr. Charles F. McKenna, delivered at the Niagara Falls meeting of the Am. Inst. of Chem. Engrs. 2500 w. Met & Chem Engng—Aug., 1910. No. 16113 C.

Outline of a Course in Machine Work. E. H. Fish. Gives a table outlining operations representative of general machine work, with remarks. 1000 w. Am Mach Vol. 33, No. 32. No. 16279.

A Descriptive List of Trade and Industrial Schools in the United States. Facts relating to the organization, administration, methods of instruction and course of study. 30000 w. Nat Soc for Pro of Ind Ed—Bul. No. 11. No. 16473 N.

Education for Efficiency in Railroad Service. D. C. Buell. Read before Assn. of Ry. Tel. Supts. Describes the educational bureau of the Union Pacific R. R. Co. and its work. 5500 w. Pro St Louis Ry Club—July 8, 1910. No. 16382.

The Wigan and District Mining and Technical College. Illustrated description of the buildings and equipment. 2500 w. Col Guard—Aug. 12, 1910. No. 16498 A.

Engineering Instruction at the Imperial Pei Yang University, Tientsin, China. Walter H. Adams. Abstract of paper read before the Soc. for Pro. of Engng. Ed. Describes the work being done at the university named. 1800 w. Eng News—Aug. 11, 1910. No. 16318.

Reform in Mining Education and the Metallurgical Industry (Die Reform des montanistischen Hochschulunterrichtes und die Hüttenindustrie). R. Vambera. Discusses the neglect of metallurgical engineering education in Austria. 2000 w. Oest Zeitschr f Berg- u Hüttenwesen—July 23, 1910. No. 16587 D.

Employers' Liability.

See Labor Insurance, under INDUSTRIAL ECONOMY.

Engineering.

Engineering Professions. Benjamin B. Lawrence. Also gives views of Eugene Klapp, and of Dr. Cary T. Hutchinson. 1700 w. Sch of Mines Qr—April, 1910. No. 16474 D.

Engineering Societies.

The New Building of the Institution of Civil Engineers. Illustrations of the façade and the floor plans of this new building in London. Engineering Magazine—Sept., 1910. No. 16738 B.

Exhibitions.

Fire at the Brussels Exhibition. An illustrated account of this disaster. 1800 w. Engr, Lond—Aug. 19, 1910. No. 16720 A.

Indexing Systems.

A Method of Indexing Engineering Information. F. Lavis. Explains a method used by the writer. 2000 w. Eng Rec—Aug. 13, 1910. No. 16324.

Industrial Museums.

The Royal Bavarian Transportation Museum in Nürnberg (Das Königl. Bayerische Verkehrsmuseum in Nürnberg). E. A. Ziffer. Describes a museum devoted wholly to railway exhibits. Ills. 7000 w. Mitt d Ver f d Förd d Lokal- u Strassenbahnwesens—July, 1910. No. 16572 F.

Japan.

Japanese Industries at the Japanese-British Exhibition. Robert H. Smith. Brief descriptions of the carpentry and timber, silk, paper and printing, tea, fisheries, and mining are given in the present articles. 2500 w. Engr, Lond—July 29, 1910. Serial. 1st part. No. 16252 A.

Labor.

Labor Conditions in American and German Machine Shops and Foundries. W. H. Dooley. An interesting comparison. 2500 w. Mach, N Y—Aug., 1910. No. 16109 C.

Employers and Employees (Employeurs et Employés). Maurice Bellom. A general discussion of the labor problem, referring particularly to conditions in France. Ills. 11200 w. Tech Mod (Sup)—July, 1910. No. 16528 D.

Labor Insurance.

The New Employers' Liability Law, New York. Gives a recently passed act amending the labor law in relation to workmen's compensation in certain dangerous employments. 2500 w. Eng Rec—Aug. 27, 1910. No. 16663.

Management.

The Twelve Principles of Efficiency. Harrington Emerson. This fourth article of a series discusses the second principle: common sense. 5000 w. Engineering Magazine—Sept., 1910. No. 16740 B.

Time-Keeping and Labour Distribution in the Foundry. Victor R. Claydon. Fourth and concluding number of a serial, discussing methods of obtaining true costs of castings. 2500 w. Engineering Magazine—Sept., 1910. No. 16742 B.

Industrial Betterment. H. F. J. Porter. Discusses modern methods of administration of workshops. 6500 w. Cassier's Mag—Aug., 1910. No. 16287 B.

Patents.

The Uniform Patent Law (Disegno di Legge sulle Privative industriali). Reviews the work of previous congresses and reports the findings of the Congress held at Brussels, June 2-5, 1910. Serial. 1st part. 4500 w. Industria—July 3, 1910. No. 16567 D.

Profits.

Manufacturing Profits and Losses. Henry Hess. A study of relationship between capitalization, invested capital, labor, material, output, and size of plant. 2200 w. Engineering Magazine—Sept., 1910. No. 16745 B.

We supply copies of these articles. See page 158.

Purchasing.

The Purchasing of Material. L. S. Randolph. Briefly considers the subject under the divisions of quantity, quality and price. 1500 w. Cassier's Mag—Aug., 1910. No. 16290 B.

Specifications.

Government Specifications. An Example of Neglect of Three Efficiency Principles. F. Percival. Points out the inefficiency from non-observance of common sense, fair deal, and expert advice. 2000 w. Engineering Magazine—Sept., 1910. No. 16741 B.

Tariffs.

The Proposed Japanese Tariff and Its Effect on British Trade. A report summarizing the character and purpose of the new tariff, tabulating the old rates and the new, indicating the course of British trade with Japan in recent cases and the comparative growth of British, German and United States trade, and giving an analysis of British imports from Japan. 11000 w. British Tariff Commission—July, 1910. No. 16257 N.

Time-Keeping.

Time Computing Devices (Arbeitzeit-Zähler). Jul. H. West. Describes devices manufactured by C. & E. Fein, Stuttgart. Ills. 2500 w. Tech u Wirt—July, 1910. No. 16794 D.

MARINE AND NAVAL ENGINEERING.

Battleships.

Comparison of the Argentine Battleship "Rivadavia" with the "Wyoming." Illustrations and comparison of the Argentine, and the United States battleships now under construction in the United States. 2000 w. Sci Am—Aug. 27, 1910. No. 16657.

Coal Consumption.

A Method of Estimating the Coal Consumption of Vessels at Various Speeds. Ormond L. Cox. Aims to show that an equation may be deduced that will contain all possible powers of the speed. Curves. Short discussion. 2500 w. Jour Am Soc of Nav Engrs—Aug., 1910. No. 16749 H.

Colliers.

Design for a Naval Collier. R. E. Barry. Illustrated description of a vessel designed to meet stated conditions. 1200 w. Int Marine Engng—Aug., 1910. No. 16200 C.

Cruisers.

Comparative Trials of Scout Cruisers Birmingham, Salem, Chester. W. W. White. Report of an extensive series of tests carried out with a view to comparing steam expenditures of reciprocating and turbine propelling machinery. Ills. and charts. 25000 w. Jour Am Soc of Nav Engrs—Aug., 1910. No. 16748 H.

H. M. Protected Cruiser "Newcastle." Illustrated description of this vessel, a type of the light unarmored ships intended for reconnaissance work. 1500 w. Plates. Engng—Aug. 19, 1910. No. 16714 A.

Italian Armored Cruiser S. Giorgio. Dagnino Attilio. Illustrated description of the third of four cruisers building for the Italian navy. 800 w. Int Marine Engng—Aug., 1910. No. 16198 C.

Destroyers.

Modern Torpedo Boat Destroyers. Considers present tendencies, and the features characterizing the new type of destroyers. 3500 w. Int Marine Engng—Aug., 1910. No. 16201 C.

Description and Trials of U. S. Torpedo-Boat Destroyers Smith and Lamson. W. B. Robins. Ills. 10800 w. Jour Am Soc of Nav Engrs—Aug., 1910. No. 16798 H.

U. S. S. Preston. William Ashby Leavitt, Jr. Illustrations, descriptions and report of official tests. 6000 w. Jour Am Soc of Nav Engrs—Aug., 1910. No. 16800 H.

Brazilian Torpedo Boat-Destroyers. Information concerning the ten vessels, all of one design, built in England for the Brazilian Government. 1000 w. Engng—Aug. 19, 1910. No. 16715 A.

Dredges.

The Fruhling Suction Dredge. John Reid. A discussion of the suction hopper dredge and illustrated detailed description of the improved dredge invented by Otto Fruhling and its history. Discussion. 6500 w. Pro Engrs' Club of Phila—July, 1910. No. 16395 D.

Electric Power.

The Electric Propulsion of Ships. Atholl Blair and J. F. Wilson. Gives particulars of equipment suggested for the cross-channel vessel, "Londonderry." 2500 w. Elect'n. Lond—Aug. 19, 1910. No. 16709 A.

Hydroplanes.

The Possibilities of the Hydroplane. Discusses the hydroplane boat, "Miranda IV," showing the principles on which she is constructed. 1700 w. Engng—Aug. 5, 1910. No. 16353 A.

A Hydroplane with Both Sub-Surface and Gliding Planes (Hydroplane mit unterwasser-Flächen und Gleitflächen). Fr. Wm. Seekatz. Describes a novel hydroplane designed by Henri Fabre. Ills. 1800 w. Motorwagen—July 31, 1910. No. 16772 D.

We supply copies of these articles. See page 158.

Internal-Combustion Motors.

Internal Combustion Engines for Navy Launches. W. G. Diman. Report of tests at the U. S. Navy Yard, Norfolk, Va., to settle upon suitable types for use in the navy service, with conclusions. Also Lloyd's rules for internal-combustion engines. 7000 w. Jour Am Soc of Nav Engrs—Aug., 1910. No. 16799 H.

Oil Fuel.

See Steam Boilers, under MARINE AND NAVAL ENGINEERING.

Propellers.

Screw Propellers. C. W. Dyson. Gives method of designing screw propellers, based on Froude's theory as applied by Barnaby and on actual trials of vessels over a measured mile course. Charts. 5000 w. Jour Am Soc of Nav Engrs—Aug., 1910. No. 16747 H.

Comparative Propeller Tests (Vergleichsversuche mit Schiffschrauben). A. Pröll. Results of tests designed to determine the comparative efficiency of the Lorenz propeller. Ills. 5500 w. Zeitschr d Ver Deutscher Ing—July 16, 1910. No. 16785 D.

Salvage.

A Proposed Method for Raising the "Maine" from Havana Harbor. Illustrated explanation of the raising operation proposed by John F. O'Rourke. 2000 w. Eng News—Aug. 4, 1910. No. 16173.

Raising the "Maine." Illustration and brief description of the plan proposed by John F. O'Rourke. 1000 w. Sci Am—Aug. 20, 1910. No. 16430.

Floating and Repairing the Nero. Abstract from *Reactions*, illustrating and describing the salvage and repair of this U. S. collier, which was stranded on rocks near Newport, R. I. The compressed-air method was used. 1200 w. Compressed Air—Aug., 1910. No. 16402.

Shipbuilding.

The Vulcan Company's New Yard at Hamburg. Illustrated detailed description of a new shipyard on the Elbe, for repairs on warships. Plate. 5000 w. Engng—July 29, 1910. Serial. 1st part. No. 16251 A.

Ship Design.

Evolution in Naval Construction (L'Evolution dans les Systèmes de Constructions navales). M. G. Hart. Discusses recent proposals for altering the disposition of the framework of ships. Ills. 10000 w. Mem Soc Ing Civ de France—May, 1910. No. 16503 G.

Ship Inspection.

Shipping and the Protection of Public Safety (La Nave e la Tutela della pubblica Incolumita). Guilio Ingianni. A review of the practice of various countries in the inspection and registration of shipping. 15500 w. Riv Marit—July-Aug., 1910. No. 16556 E + F.

Steam Boilers.

Oil Fuel Installation on Steamships Yale and Harvard. Illustrates and describes the arrangement of piping, burners and superheating on boilers, etc. 1200 w. Int Marine Engng—Aug., 1910. No. 16199 C.

The Question of Boilers for Warships (La Question des Chaudières dans la Marine de Guerre). Discusses the diversity of types in use and their characteristics. 5600 w. Tech Mod—July, 1910. No. 16530 D.

See also Boiler Explosions, under MECHANICAL ENGINEERING, STEAM ENGINEERING.

Steamships.

The Cunard Steamship Franconia. Illustrated description of an interesting vessel of the intermediate class for the Boston service. 2500 w. Engr, Lond—Aug. 5, 1910. No. 16358 A.

Steam Turbines.

The Steam Turbine in the German Navy. Fr. Bock. Brief illustrated account of the application of the steam turbine to cruisers and torpedo boats. 700 w. Cassier's Mag—Aug., 1910. No. 16289 B.

Notes on the Operation and Management of the Curtis Turbines on the U. S. S. Salem. W. W. Smith. A brief guide, to their care, operation and management. Ills. 8500 w. Jour Am Soc of Nav Engrs—Aug., 1910. No. 16801 H.

MECHANICAL ENGINEERING.

AUTOMOBILES.

Agricultural.

See also Tractors, under AUTOMOBILES.

Alldays.

The 14-18 H. P. Alldays Car. Illustrated description of an English built car having forced lubrication. 1000 w. Autocar—Aug. 20, 1910. No. 16692 A.

Bedford.

The Bedford "Fifteen-Eighteen." Illustrated description of the construction of the chassis. 1200 w. Auto Jour—Aug. 20, 1910. No. 16693 A.

Cab.

Accounting Methods for the Taxicab Business. H. H. Wesener. Gives forms, blanks and methods of keeping all necessary records. 2500 w. Horseless Age—Aug. 3, 1910. No. 16184.

Some Comment on Taxicab Mainte-

nance. John Squires. A discussion from the manufacturers' standpoint of the causes of excessive maintenance expense and the remedies. 3000 w. Horseless Age—Aug. 17, 1910. No. 16452.

Influence of Standardization on Taxicab Operation. Richard W. Meade. Considers its effect on earnings, expenses, etc. 1500 w. Horseless Age—July 27, 1910. No. 16054.

New York's Taxicab Industry. An illustrated account of the business and methods. 2500 w. Horseless Age—July 27, 1910. No. 16046.

Taxicab Situation in Chicago. Illustrated report of the condition and methods. 2500 w. Horseless Age—July 27, 1910. No. 16047.

Taxicab Services in Boston. Illustrated account of the conditions and service. 1500 w. Horseless Age—July 27, 1910. No. 16048.

Taxicabs in Philadelphia. Brief account of the service. Ills. 1000 w. Horseless Age—July 27, 1910. No. 16049.

Los Angeles Taxicab Situation. Summary of the companies operating and report of the service. 1200 w. Horseless Age—July 27, 1910. No. 16050.

Taxicab Progress in Great Britain. Roy Lindsay. An account of the astonishing increase during the past year, due principally to the low fares. 1500 w. Horseless Age—July 27, 1910. No. 16051.

Motor Cabs in Berlin. Dr. Ernest Valentin. Illustrates and describes the cabs now used, and gives prescribed regulations. 1200 w. Horseless Age—July 27, 1910. No. 16052.

Carbureters.

New Carbureter Principle. Illustrates a new idea involving the use of a differential compensating valve, automatic in its action without interfering with hand-control. 4000 w. Automobile—Aug. 25, 1910. No. 16652.

The Vortex Vaporizer. Describes a new idea in carbureter designing; fuel is heated to overcome the latent heat of evaporation. Ills. 5000 w. Automoible—Aug. 25, 1910. No. 16651.

Carburation Extraordinary. An account of the practical achievements of the "Polyrhoe" carburettor. Ills. 3000 w. Auto Jour—Aug. 13, 1910. No. 16482 A.

Commercial Vehicles.

The Clark Power Wagon. Illustrated detailed description. 2500 w. Automobile—Aug. 11, 1910. No. 16305.

Motor Trucks for Railroad Service. Extracts from a paper read at the S. A. E. convention by T. V. Buckwalter. Discusses their use for transfer of freight and baggage, and for other purposes. Ills. 2200 w. Automobile—Aug. 4, 1910. No. 16178.

Construction.

Use of Pressed Steel in Motor Cars. John Coapman. Remarks on the use of forgings and sheet steel stampings in place of castings. Ills. 1000 w. Am Mach—Vol. 33. No. 34. No. 16612.

Crank Motions.

The "Kilby" Crank-Motion for Petrol Engines. Illustrated description of a new device embodied in the Kilby system. The novel feature lies in the construction of the crank-shaft and of the big end of the connecting-rod. 1700 w. Auto Jour—Aug. 6, 1910. No. 16337 A.

Design.

European Tendencies in Design. Louis Ruthenburg. Discusses features of motor cars being adopted by European engineers and their probable application in the United States. 1500 w. Horseless Age—Aug. 17, 1910. No. 16454.

Electric.

Electric Automobiles in the United States Government Service. Waldon Fawcett. Descriptions and illustrations of some machines made for special services. 2000 w. Elec Rev, N Y—Aug. 13, 1910. No. 16335.

Electric Automobiles (Les Automobiles électriques). J. A. Montpellier. Describes the application of the Génard "Phoenix" accumulator in electric vehicles. Ills. 2500 w. L'Elecn—July 30, 1910. No. 16542 D.

Electric Batteries.

The Charging of Ignition Batteries (Selbstaufladen von Zündbatterien). K. Stauffer. Describes methods by which the owner of a car can do his own charging. Ills. 3000 w. Zeitschr d mit Motorwagen Ver—July 31, 1910. No. 16753 D.

Fire Apparatus.

Developments in Self-Propelled Fire Apparatus. Illustrates and describes recent gas motor fire engines equipped with power driven centrifugal and reciprocating water pumps. Also types of auto chemical engines and hose wagons. 2000 w. Com Veh—Aug., 1910. No. 16076 C.

Glasgow's Motor Fire Engines. Illustrates and describes two petrol motor fire engines of the centrifugal or turbine-pump type. 1000 w. Engr, Lond—July 29, 1910. No. 16253 A.

Automobile Fire Apparatus (Kraftwagen im Dienst der Feuerwehr). Herr Lehmann. Compares steam, electric and combustion-motor operation. 2500 w. Zeitschr d Ver Deutscher Ing—July 2, 1910. No. 16781 D.

Fuel Systems.

The Pressure Feed System on Motor Cars. Harold Whiting Slauson. Diagram and description of the arrangement and function of its parts. 3000 w. Motor Car Jour—Aug. 20, 1910. No. 16660 A.

Gear Boxes.

Gear Boxes on Back Axles. An impartial discussion with conclusions. 1500 w. Autocar—Aug. 13, 1910. No. 16481 A.

We supply copies of these articles. See page 158.

Why Are Gear Boxes Noisy? Suggests various lines of investigation to solve the problem. 3000 w. Autocar—Aug. 6, 1910. No. 16338 A.

Gears.

Transmission of an Automobile. K. W. Najder. Mathematical. 500 w. Automobile—Aug. 18, 1910. No. 16448.

Graham Differential. Illustrates and describes details of design and construction of this gear of the overhauling type. 900 w. Automobile—Aug. 25, 1910. No. 16653.

Halladay.

The Halladay Automobile for 1911. Illustrated description of a car so made that it can be converted from a touring car to a fore-door type. 1500 w. Automobile—Aug. 25, 1910. No. 16654.

Hillman.

The 12-15 H. P. Hillman Car. Illustrated description, especially explaining the lubricating system. 1200 w. Autocar—July 30, 1910. No. 16229 A.

Ignition.

Automatic Ignition Advance. Illustrated description of a German system. 700 w. Autocar—July 30, 1910. No. 16230 A.

Lighting.

A Permanent-Magnet Car Dynamo. Illustrates and describes the characteristics of this dynamo. 1200 w. Auto Jour—July 23, 1910. No. 16124 A.

Lubrication.

Car-Motor Ideal Lubrication. Hugh Dolnar. A review of the various systems of lubrication for automobile motors, favoring the continuous oil circulating system. Ills. 2500 w. Am Mach—Vol. 33. No. 32. No. 16278.

Semi-Automatic Drip-Feed Lubricator. Illustrated description of a new type intended primarily for motor cycles and small cars. 600 w. Engr, Lond—July 29, 1910. No. 16255 A.

See also Lubricants, under POWER AND TRANSMISSION.

Motors.

Some Foreign Piston Valve Motors. Illustrates and describes recent English and French designs brought out mainly with the view of eliminating valve noises and increasing the power. 1500 w. Horseless Age—Aug. 3, 1910. No. 16186.

Motor Valves.

Slide, Rotary and Piston vs. Poppet Valves. Eugene P. Batzell. Read at meeting of Soc. of Auto. Engrs. Detailed discussion of the merits of various types, and the trouble with noise in poppet valves. 1800 w. Automobile—Aug. 4, 1910. Serial. 1st part. No. 16182.

Omnibuses.

The Motor-Omnibus Concession in Paris (La Concession des Autobus de Paris). Lucien Férissé. Discusses the terms of the concession, the experience of other cities, economic aspects of motor-omnibus traffic, and the construction of the vehicles. Ills. 30000 w. Mem Soc Ing Civ de France—June, 1910. No. 16510 G.

Peugeot.

The 10-14 H. P. Peugeot Model. Illustrated detailed description. 1200 w. Auto Jour—Aug. 13, 1910. No. 16483 A.

Road Resistance.

Measurements of Road Resistance of Automobiles. H. E. Wimperis. Reports two road resistance tests made by the author. 700 w. Eng News—Aug. 4, 1910. No. 16174.

Road Trains.

The New Daimler Road Train. Illustrated detailed description of the improved Renard train and its operation. 3500 w. Auto Jour—July 30, 1910. No. 16231 A.

Speed.

Judging a Car's Speed. Charles B. Hayward. Shows that many factors tend to make the estimates unreliable. 2000 w. Horseless Age—Aug. 17, 1910. No. 16453.

Starting.

Starting on the Spark. Dr. Charles W. Snyder. Considers the theory of starting a multi-cylinder engine by simply manipulating the spark lever and factors determining the success of the operation. 1000 w. Horseless Age—Aug. 24, 1910. No. 16681.

Supplies.

The Carrying of Tools, Spare Tires and Supplies. H. H. Brown. Extracts from a paper read at S. A. E. convention, explaining practical methods tending to secure cleanliness, convenience and economy. Ills. 1800 w. Automobile—Aug. 4, 1910. No. 16180.

Taximeters.

Taximeters and Their Operation. Douglas R. Hobart. Explanation, with diagrams. 2000 w. Horseless Age—July 27, 1910. No. 16053.

Tire Pumps.

Automatic Tire Pumps. Illustrates and describes a type worked by suction and compression from the motor cylinder with an air pump in tandem relation. 1000 w. Automobile—Aug. 25, 1910. No. 16650.

Tractors.

Tractors at the Royal Agricultural Society's Trials at Baldock. Illustrated brief descriptions of the Mann agricultural motor, the Ivel agricultural motors, and the Wallis and Steevens steam tractor. 1000 w. Engng—Aug. 12, 1910. No. 16602 A.

The Saunderson Agricultural Tractors. Illustrated description of two tractors which took part in the trials of the Royal Agricultural Society, with editorial. 2800 w. Engng—Aug. 19, 1910. No. 16718 A.

Traction Plowing Outfits—Operating

We supply copies of these articles. See page 158.

Methods and Costs. L. W. Ellis. From Bul. No. 170 U. S. Dept. of Agri. Detailed discussion of factors affecting the economy. 7000 w. Engng-Con—Aug. 24, 1910. No. 16623.

COMBUSTION MOTORS.

Aeronautic Motors.

French Aeroplane Motors. Warren H. Miller. An illustrated review of six leading types. 2500 w. Engineering Magazine—Sept., 1910. No. 16744 B.

Gas-Engine Tests.

Gas-Engine Test Records. W. A. Tookey. Remarks on the worthlessness of test figures, and discussing the question of frictional horse-power in the present number. 3000 w. Mech Wld—Aug. 19, 1910. Serial. 1st part. No. 16699 A.

Gasoline Engines.

A New Departure in Two-Stroke Engines. Illustrated description of a novel type of two-stroke gasoline engine, designed by G. Enderby and H. Johnson. 1000 w. Sci Am Sup—Aug. 20, 1910. No. 16433.

Gas Power Plants.

Suction Gas Plants in Western Australia. M. von Bernewitz. Descriptive notes collected on visiting all the plants at work. 3000 w. Min Jour—July 30, 1910. No. 16242 A.

Gas Producers.

Gas Producers. J. Hofmann. Abstract of a paper before the Int. Cong. at Dusseldorf. Discusses the requirements of a good producer and illustrates and describes types. 3000 w. Ir & Coal Trds Rev—July 22, 1910. No. 16154 A.

Deutz Suction Gas Producers (Gazogènes aspirants de la Gasmotorenfabrik de Deutz près Cologne). Describes briefly the two types, for coke or anthracite, and for lignite briquettes. Ills. 2000 w. Génie Civil—July 23, 1910. No. 16551 D.

Producer Gas.

American Producer Gas Practice. A. J. McCarte. Awarded the Mary Starr Stillman prize in Applied Technology, 1910. A review of the industry, discussing fuels used for gas producers. 2500 w. Stevens Ind—July, 1910. Serial. 1st part. No. 16388 D.

HEATING AND COOLING.

Central Plants.

The Profitable Operation of a Central Heating Station Without the Assistance of Electrical or Other Industries. Byron T. Gifford. Read before the Nat. Dist. Heat. Assn. Gives a statement showing that such a plant may be made a physical and a financial success. Discussion. 2500 w. Heat & Vent Mag—Aug., 1910. No. 16405.

Central Heating at Crawfordsville, Ind. Illustrated description of a hot-water heating system designed for 300,000 sq. ft. of radiation; steam-turbine water-circulating pumps, and air suction for removing ashes. 3500 w. Met Work—July 30, 1910. No. 16045.

Cooling Towers.

The Testing of Cooling Towers. Wilfred Yorke. Shows how the data were obtained and calculated, and how more efficient service could have been obtained. 1500 w. Power—Aug. 30, 1910. No. 16735.

Fans.

Tests of Ventilating Fans (Untersuchungen an Ventilatoren für Lüftungsanlagen). K. Brabbée and M. Berlowitz. Describes methods and gives results of fan tests at the Berlin Technical High School. Ills. 5500 w. Zeitschr d Ver Deutscher Ing—July 30, 1910. No. 16789 D.

Hot Air Heating.

Tests of Cast-Iron Hot Blast Heaters. L. C. Soule. Explains new methods of testing and gives a new formula designed to cover all hot-blast heating conditions. Ills. 2000 w. Heat & Vent Mag—Aug., 1910. No. 16406.

Plumbing.

Plumbing of Federal Buildings. Nelson S. Thompson. Describes government practice in the plumbing, drainage and water supply of buildings erected under control of the supervising architect. 2000 w. Met Work—Aug. 27, 1910. Serial. 1st part. No. 16671.

Fixing Iron or Copper Pipes for Hot Water. J. Wright Clarke. Suggestions for satisfactory work, illustrating appliances used. 1800 w. Dom Engng—Aug. 13, 1910. No. 16367.

Refrigeration.

Cold and Its Production. F. E. Matthews. Discusses heat, its effects, units by which it is measured, laws governing its flow, and applications to refrigeration. 3500 w. Power—Aug. 2, 1910. No. 16071.

Mechanical Refrigeration. F. E. Matthews. Short review of the history of the development. 2500 w. Power—Aug. 9, 1910. No. 16261.

Mechanical Refrigeration. F. E. Matthews. An elementary treatment of commercial systems with simple illustrations to show the principles of operation. 3500 w. Power—Aug. 23, 1910. No. 16470.

New Vacuum Machine. Illustrates and describes a French ice machine in which the vacuum is produced by a steam jet and a vacuum condenser. 1800 w. Ice & Refrig—Aug., 1910. No. 16204 C.

Absorption Machine Problems. Robert H. Kirk and H. Sloan. Gives diagrams for calculations and examples showing their use. 2000 w. Ice & Refrig—Aug., 1910. No. 16206 C.

Baker Chocolate Cooling Plant. Details of the refrigerating plant in the factories at Dorchester, Mass., are illustrated and described. 1500 w. Ice & Refrig—Aug., 1910. No. 16205 C.

We supply copies of these articles. See page 158.

The Precooling Plants of the Pacific Fruit Express Company. Illustrated description of plants recently built in California, which provide for the passage of large volumes of cold air through loaded cars before they are iced. 3000 w. Eng Rec—July 30, 1910. No. 16060.

HYDRAULIC MACHINERY.

Centrifugal Pumps.

A New Centrifugal Pump. Illustrates and describes types of the Hayward-Tyler turbo pump. 800 w. Engr, Lond—July 22, 1910. No. 16151 A.

Clearance Losses in Fans and Centrifugal Pumps (Der Spaltverlust bei Ventilatoren und Kreiselpumpen). M. Vidmar. Mathematical. Ills. Serial. 1st part. 2500 w. Zeitschr f d Gesamte Turbinenwesen—July 30, 1910. No. 16751 D.

Exhibitions.

German Hydraulic Engineering at the Brussels Exhibition Describes a very interesting exhibit. 2500 w. Engng—Aug. 19, 1910. No. 16717 A.

Gas Pumps.

The Humphrey Gas-Pump. Illustrated description of an internal-combustion pump shown at the Brussels exhibition. 2000 w. Engng—July 22, 1910. No. 16142 A.

Pumping Plants.

Combined Fire and Domestic Service Pumping Plants. Brief illustrated description of two small installations in California. 900 w. Eng Rec—Aug. 27, 1910. No. 16668.

Pumps.

A New Boiler Feed Pump. Illustrates and describes a direct-acting feed pump with a new form of valve gear. 1000 w. Engr, Lond—Aug. 19, 1910. No. 16722 A.

Surges.

The Theory of Surges (Sulla Teoria della "Houle"). P. Alibrandi. A mathematical study. Ills. 6500 w. Ann d Soc d Ing e d Arch Ital—July 15, 1910. No. 16560 F.

Turbine Governing.

The Indirect Regulation of Turbines with Special Reference to the Inertia of the Water (Die indirekte Regulierung der Turbinen mit Berücksichtigung der Massenträgheit des Zuflusswassers). J. Magg. Mathemtaical. Ills. Serial. 1st part. 3500 w. Zeitschr f d Gesamte Turbinenwesen—July 10, 1910. No. 16599 D.

Turbines.

Hydraulic Turbines for 670-Foot Head. H. Birchard Taylor. Describes two 6000-h.p. reaction turbines to be operated under a 670-foot head at Noriega, Mex. Ills. 3000 w. Am Mach—Vol. 33. No. 33. No. 16421.

Water Hammer.

The Calculation of Water Hammer in Conduits under Pressure (Note sur le Calcul du Coup de Bélier dans les Conduites d'Eau sous Pression). A. Vaucher. A mathematical exposition of Alliévi's theory. Serial. 1st part. 2300 w. Bul Tech d l Suisse Romande—July 10, 1910. No. 16534 D.

Water Wheels.

Effect of the Length of Penstock on the Weight of Revolving Parts of a Water-Wheel Unit. George M. Peek. Mathematical discussion, developing and applying formulae. 1200 w. Eng News—Aug. 11, 1910. No. 16314.

The Testing of Water Wheels After Installation. Discussion of C. M. Allen's paper. 5500 w. Jour Am Soc of Mech Engrs—Aug., 1910. No. 16299 F.

MACHINE ELEMENTS AND DESIGN.

Ball Bearings.

Construction and Use of Ball-Bearings. J. D. Waern. Read before the Vic. Inst. of Elec. Engrs. Discusses roller and ball-bearings, analyzing losses in them by friction and the rules governing their construction. 2000 w. Aust Min Stand—July 6, 1910. Serial. 1st part. No. 16417 B.

Bearings.

See also Bearing Metals, under MATERIALS OF CONSTRUCTION.

Designing.

The Designers' Tools (L'Outillage technique et pratique du Dessinateur). Jean Escard. The first part describes and discusses draughting tables and boards. Ills. Serial. 1st part. 4500 w. Rev de Mécan—July, 1910. No. 16524 E + F.

Gears.

Interchangeable Involute Gearing. Wilfred Lewis. Suggests a system having a pressure angle of 22½ degrees, and an addendum of 0.278 of the circular pitch. Ills. 3300 w. Jour Am Soc of Mech Engrs—July, 1910. No. 16418 F.

Tooth Gearing. J. D. Steven. A discussion of involute gear teeth and the advantage of a uniform tooth. Ills. 4000 w. Inst of Mech Engrs—July, 1910. No. 16248 N.

Special Bevel Gears. F. E. Watts. Discusses principles involved in their layout, and methods of calculation. 800 w. Horseless Age—Aug. 3, 1910. No. 16185.

Riveted Joints.

The Strength of Riveted Joints. Patrick J. Sweeney. Explanation given by a foreman boiler maker to his apprentices. Ills. 2500 w. Boiler Maker—Aug., 1910. No. 16264.

Eccentrically Loaded Bolt and Rivet Groups. M. Terry. A mathematical discussion of the principles involved in designing riveted joints. 800 w. Mach, N Y—Aug., 1910. No. 16104 C.

See also Steel, under CIVIL ENGINEERING, MATERIALS OF CONSTRUCTION.

MACHINE WORKS AND FOUNDRIES.

Automatic Machines.

Slide Rule in Screw Machine Work. George D. Hayden. Shows how accurate

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results can be easily and quickly obtained. 1500 w. Am Mach—Vol. 33. No. 34. No. 16615.

Balancing Machine.

Principles of Running Balance. Presents results and conclusions from tests made on a Norton running balance machine. Ills. 4500 w. Am Mach—Vol. 33. No. 32. No. 16276.

Brass Founding.

Why Brass Castings Often Fail. A. Napier, in *Found. Trd. Jour.* Discusses some of the essentials for good work. 2000 w. Mech Wld—Aug. 19, 1910. No. 16701 A.

Case Hardening.

Theoretical and Practical Notes on Case Hardening (Quelques Observations théoriques et practiques sur la Cémentation). L. Guillet. Read at the Düsseldorf Congress Discusses cementing materials, time, temperature, etc. 2200 w. Rev de Métal—July, 1910. No. 16515 E + F.

Heat Treatment of Cemented Products (Traitements Thermiques des Produits Cémentes). L. Guillet. Read at the Düsseldorf Congress. Discusses the tempering of case-hardened materials. Ills. 2500 w. Rev de Métal—July, 1910. No. 16516 E + F.

Castings.

Runners, Gates, and Dirty Castings. Considers especially the sources of dirt and the means of securing clean castings. Ills. 2500 w. Mech Wld—July 22, 1910. No. 16138 A.

Sinking Heads and Sound Castings. Thomas Kennedy. Read before the Assn. of Water Engrs. Brief discussion of the effect of a sinking head on large castings, showing the advantages and desirability. Ills. 800 w. Engng—July 22, 1910. No. 16146 A.

Pickling Castings and Dips Used. Gives receipts for obtaining different kinds of finish. 1000 w. Am Mach—Vol. 33. No. 34. No. 16614.

Distortions in Castings (Ueber das Krummziehen von Gussstücken nach dem Gusse). H. Vetter. Discusses the causes of the distortion of castings on cooling. Ills. Serial. 2 parts. 2500 w. Giesserei-Zeit—July 1 and 15, 1910. No. 16583 each D.

Cupola Practice.

Notes on the Melting of Iron in Cupolas. A. J. Ehrob. Explanation of the changes brought about in the cupola and their regulation. 3000 w. Foundry—Aug., 1910. No. 16082.

Cutting Tools.

Multiple Cutter Tools. W. S. Giele. Discusses the considerations governing the number of cutting edges in a boring or turning tool. 1500 w. Mach, N Y—Aug., 1910. No. 16103 C.

Enamelling.

An Investigation of Enamel for Cast Iron (Untersuchungen von Gusseisen-Emails). Julius Grünwald. Reports results and conclusions of a large number of tests. 3500 w. Stahl u Eisen—July 13, 1910. No. 16579 D.

Forging.

Influence of Improvements in Heating Furnaces on the Development of Mechanical Forging (Influence du Perfectionnement des Méthodes de Chauffage sur le Développement du Forgeage mécanique). MM. Androuin and Stein. Read at the Düsseldorf Congress. 3000 w. La Métal—July 27, 1910. No. 16543 D.

Forging Presses.

High Speed Forging Press. Explains the advantages and gives an illustrated description of machines developed by Davy Bros., Inc. of Sheffield, Eng. 1700 w. Am Engr & R R Jour—Aug., 1910. No. 16197 C.

Foundries.

The Equipment of a Modern Specialty Foundry. Illustrated description of fittings used in a foundry at Providence, R. I., where fire extinguishing apparatus is made. 1500 w. Castings—Aug., 1910. No. 16415.

A Modern Railroad Repair Foundry. Illustrated description of the new casting shop of the D., L. & W. R. R. at Scranton, Pa. 1500 w. Foundry—Aug., 1910. No. 16084.

Foundry Coke.

Coke and Its Properties. F. K. Knowles. Read before the British Found. Assn. Information from the laboratory and from the practical coke user. 3500 w. Col Guard—Aug. 19, 1910. No. 16711 A.

Coke and Its Properties. F. K. Knowles. Read before the British Found. Assn. Considers the points upon which the chemist can give information, and the selection of coke by the practical coke user, etc. 3000 w. Mech Engr—Aug. 12, 1910. No. 16497 A.

Foundry Materials.

The Comparative Values of Foundry Annealing Ores. F. H. Hurren. Gives analyses of typical ores, and discusses the right composition. 800 w. Ir & Coal Trds Rev—Aug. 19, 1910. No. 16726 A.

Foundry Practice.

Bell Founding in Old France. Joseph G. Horner. Illustrated description of practice previous to 1777. 1500 w. Mach, N Y—Aug., 1910. No. 16110 C.

Present Status of Foundry Practice in Germany (Ueber den heutigen Stand des Giessereiwesens in Deutschland). C. Irresberger. Read at the Düsseldorf Congress. Ills. 3500 w. Stahl u Eisen—July 13, 1910. No. 16577 D.

Furnaces.

Oil Burning Melting Furnace. H. A. Evans. Illustrated description of a furnace made of sheet metal and structural

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steel, lined with fire brick with a hearth of dolomite. 1500 w. Am Mach—Vol. 33. No. 34. No. 16613.

Gear Cutters.

Making Cutters for Gear Teeth. F. A. Stanley. Illustrates and describes special machines and appliances and their manufacture. 2500 w. Am Mach—Vol. 33. No. 34. No. 16610.

Grinding.

Grinding Automobile Cylinders. James N. Heald. Gives some problems in automobile building, which have been solved by the grinding machine. 4000 w. Am Mach—Vol. 33. No. 32. No. 16280.

Grinding Machines.

Grinding Machinery and the Manufacture of Grinding Wheels. John H. Davy. Read before the Glasgow Tech. Col. Sci. Soc. Information concerning the development of grinding machines, the abrasives used, their manufacture, etc. Ills. 4500 w. Mech Engr—Aug. 5, 1910. No. 16348 A.

Jigs.

Pertinent Points on Jig and Fixture Design. C. Nosrac. Notes on materials, devices, and methods. 1800 w. Mach, N Y—Aug., 1910. No. 16107 C.

Lathes.

A Double-Bedded Turbine Lathe. Illustrated description of the Harvey turbine lathe. 1000 w. Engr, Lond—Aug. 5, 1910. No. 16361 A.

A New High-Speed Wheel Lathe. Illustrated description of a machine supplied by Loudon Brothers, Ltd., to the Central South African Railways. 1000 w. Engr, Lond—July 29, 1910. No. 16256 A.

3¾-In. and 4½-In. Screw-Cutting Foot-Lathes. Illustrates and describes two new models introduced by the Britannia Engng. Co. 700 w. Engng—Aug. 19, 1910. No. 16719 A.

Machine Tools.

High-Speed Tools and Machines to Fit Them. H. I. Brackenbury. Remarks on high-speed tool steel, its use and applications, and the machines fit for its use. Ills. 6000 w. Inst of Mech Engrs—July, 1910. No. 16250 N.

Machine Tools at the Brussels Exhibition (Die Werkzeugmaschinen auf der Brusseler Weltausstellung 1910). Franz Adler. A preliminary report. Ills. 4000 w. Zeitschr d Ver Deutscher Ing—July 16, 1910. No. 16784 D.

Metal Cleaning.

The Metal-Cleaning Plant at the A. E. G. Cable Works at Oberspree (Die Metallteil-Beizerei im Kabelwerk Oberspree der Allgemeinen Elektricitäts-Gesellschaft). Franz Adler. Detailed description of a plant for cleaning copper wire. Ills. 2000 w. Zeitschr d Ver Deutscher Ing—July 30, 1910. No. 16791 D.

Milling.

Locating Indicator for the Miller. George J. Murdock. Illustrated description of a device for locating jigs and other tool work on the milling-machine table. Gives details of construction and method of applying to various classes of work. 1200 w. Am Mach—Vol. 33. No. 34. No. 16611.

Molding.

Cylinder Molding in an English Shop. Illustrates and describes the method of molding locomotive cylinders in the foundry operated by the Midland Ry. Co., Derby, England. 3000 w. Foundry—Aug., 1910. No. 16081.

Molding a Marine Engine Bed Plate. Joseph Horner. Illustrated explanation of the method of constructing the pattern and core boxes, making and setting the cores and finishing the mold. 1500 w. Foundry—Aug., 1910. No. 16083.

Molding a Steam Turbine Cylinder. Explains how the copes are prepared, finished and rammed, and the cores made up. Ills. 2000 w. Am Mach—Vol. 33. No. 34. No. 16616.

Molding Sand.

Magnetic Separation of Iron Particles from Molding Sand (Die elektromagnetische Separation von Formsand und eisenhaltigen Stoffen im Giessereibetriebe). Hubert Hermanns. Describes the methods and machines used. Ills. Serial. 1st part. 1800 w. Giesserei-Zeit—July 1, 1910. No. 16584 D.

Pattern Making.

Making a Pattern for a Steam Turbine. E. F. Lake. Illustrates and describes pattern-construction methods employed in a large shop on steam turbines. 2000 w. Am Mach—Vol. 33. No. 32. No. 16281.

Patterns.

Latter-Day Methods of Gating Metal Patterns. W. R. Dean. Describes the operations in detail. Ills. 2500 w. Foundry—Aug., 1910. No. 16085.

Pipe Lining.

Lead Lined Tubing. Holden A. Evans. Illustrates and describes the machinery and methods used. 2200 w. Am Mach—Vol. 33. No. 31. No. 16163.

Presses.

Pressing and Stamping (Matriçage et Découpage). A review of recent patents and literature relating to drawing presses, etc. Ills. 7500 w. Rev de Mécan—July, 1910. No. 16525 E + F.

Shop Appliances.

Dies Used in Making Fishing Reels. E. A. Dixie. Illustrates and describes tools for making reel-body ends and novel method of driving them in the lathe. 800 w. Am Mach—Vol. 33. No. 33. No. 16419.

Designing Screw Machine Tools and Cams. Douglas T. Hamilton. Describes

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methods employed in designing special tools and cams for the Brown & Sharpe automatic screw machine. Ills. 3500 w. Mach, N Y—Aug., 1910. No. 16108 C.

Shop Design.

The Routing Diagram as a Basis for Laying Out Industrial Plants. Charles Day. Shows the importance of the right arrangement of departments and equipment. Ills. 4000 w. Engineering Magazine—Sept., 1910. No. 16737 B.

Shop Heating.

The Heating of Engineering Shops. Illustrates and describes the heating apparatus installed in the shops of the Central London Railway. 1500 w. Engng—Aug. 19, 1910. No. 16716 A.

The Heating, Ventilating and Air-Conditioning of Factories. Percival Robert Moses. This second article considers the regulation of humidity, air-washing, and costs. Ills. 4500 w. Engineering Magazine—Sept., 1910. No. 15743 B.

Shop Practice.

Machine Work in the Oil Country—Making "Joints." Illustrates and describes oil-well tools and their making. 1500 w. Mach, N Y—Aug., 1910. No. 16111 C.

Cam Shaft Milling in the Lathe. H. M. York. Illustrates and describes a method of machining cams on their shafts by means of special holding fixtures and a milling attachment used in the engine lathe. 1000 w. Am Mach—Vol. 33. No. 31. No. 16164.

Machining Magnet and Stator Frames. W. Burns. A short description. Ills. 2200 w. Mech Wld—Aug. 5, 1910. No. 16350 A.

Making Open-Side Planers. Ethan Viall. Illustrated description of details introduced at the Cleveland Planer Works. 600 w. Mach, N Y—Aug., 1910. No. 16106 C.

Steel Balls. J. F. Springer. Illustrates and describes methods employed by the Standard Roller Bearing Co. in their manufacture. 2500 w. Ir Age—Aug. 11, 1910. No. 16269.

Shop Kinks. Illustrated description of devices and methods used in the Silvis Shops of the Rock Island lines. 1500 w. Ry Age Gaz—Aug. 5, 1910. No. 16193.

Shops.

New Factory of the Frank Mossberg Co. Chester L. Lucas. Illustrated description of new tool works in Attleboro, Mass. 2500 w. Mach, N Y—Aug., 1910. No. 16105 C.

The Works of Messrs. Alfred Herbert, Limited, Coventry. Illustrated detailed description of these important English machine-tool works. Plates. 10600 w. Engng—July 22, 1910. No. 16140 A.

The Works of Messrs. Haniel and Lueg, Düsseldorf. Illustrated detailed description of important industrial works in Germany. 1030 w. Col Guard—Aug. 19, 1910. Serial. 1st part. No. 16710 A.

Shop Ventilation.

The Elimination of Fumes from Dye Works (Installation d'Elimination des Buées dans les Teintureries). Paul Razous. Detailed description of an installation at Lyon, France. Ills. 2000 w. Rev d'Econ Indus—July, 1910. No. 16500 D.

Welding.

Thermit Practice in America in Welding, Casting and Metallurgy. Ernest Stutz. An illustrated discussion of the distinguishing features of the thermit process and its applications. 5000 w. Eng News—Aug. 25, 1910. No. 16628.

Oxy-Acetylene Welding and Cutting. William G. Reyer and R. W. Clark. Illustrates and describes the work. 800 w. Ry Age Gaz—Aug. 5, 1910. No. 16194.

Autogenous Welding Equipments Compared. Henry Cave. Illustrated discussion of the relative merits of the high and low pressure systems. 2200 w. Ir Age—Aug. 4, 1910. No. 16160.

Acetylene and Its Applications (L'Acétylène et ses Applications). P. Rosemberg. A review of the generation of acetylene and of its use for lighting and welding. Ills. 8000 w. Bul Soc d'Ecour—June, 1910. No. 16519 G.

Precautions to be Observed in the Use of Containers of Compressed Gas, Particularly Oxygen and Hydrogen (Sulle Precauzioni da Aversi nell' Uso dei Recipienti Contenenti Gas Liquefatti o Compressi e in Particolare Ossigeno e Idrogeno). C. Giaj-Tenua. Describes the dangers and preventative measures. Ills. Serial 1st part. 1200 w. Industria—July 31, 1910. No. 16569 D.

MATERIALS OF CONSTRUCTION.

Alloys.

The Production of Alloys of Nickel and Cobalt with Chromium. Elwood Haynes. Read before the Am. Chem. Assn. A description of interesting experiments resulting in discovery of an alloy possessing valuable properties. Ills. 2500 w. Ir Trd Rev—Aug. 4, 1910. No. 16177.

The Strength of the Alloys of Electrolytic Iron and Monel Metal. Charles F. Burgess and James Aston. A report of important research work and results. 2500 w. Met & Chem Engng—Aug., 1910. No. 16112 C.

Determination of Lead in Non-Ferrous Alloys. C. P. Karr. Explains methods of assay where lead enters in the course of foundry practice rather than to ores in which lead occurs. 3500 w. Foundry—Aug., 1910. No. 16086.

Alloy Steel.

Cupro-Nickel-Steel. G. H. Clamer. With discussion by John A Mathews. Read before Am. Soc. for Test. Mat. A study of iron-nickel and iron-copper alloys and the joint addition of nickel and copper. 3500 w. Eng News—Aug. 4, 1910. No. 16172.

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Silicon Steel. G. A. Bisset. Gives results of tests, showing its superiority over other kinds. Ills. 2500 w. Ir Age—Aug. 25, 1910. No. 16625.

Heat Treatment of Special Steels (Traitements thermiques des Aciers spéciaux). L. Guillet. Read at the Düsseldorf Congress. Deals with perlitic, martensitic, polyhedral, and carbon steels. 3000 w. Rev de Métal—July, 1910. No. 16514 E + F.

Bearing Metals.

Notes on Bearing Metals and the Design of Bearings. S. G. Winn. Discusses the composition of suitable metals and the proper design. 2000 w. Mach Wld—July 22, 1910. Serial. 1st part. No. 16139 A.

Bronzes.

The Elastic Limit of Manganese and Other Bronzes. Discussion of J. A. Capp's paper on this subject. 800 w. Jour Am Soc of Mech Engrs—Aug., 1910. No. 16298 F.

Analysis of Manganese Bronze. H. B. Swan. Outlines a method by which results which check closely were repeatedly obtained. 1200 w. Met & Chem Engng—Aug., 1910. No. 16114 C.

Cast Iron.

Malleable Cast Iron: Some of Its Features and How It Is Manufactured in Sweden. G. A. Blume. Read before the British Foun. Assn. Explains the difference between the Reaumur and American systems, and describes the work as carried on in Sweden. 4000 w. Mech Engr—Aug. 19, 1910. No. 16698 A.

Chromium in Cast Iron (Chrom im Roheisen). Max Orthey. Gives a number of analyses and other data showing its effects. 2000 w. Giesserei-Zeit—July 15, 1910. No. 16585 D.

An Investigation of Ferro-Titanium Thermit and Low-Percentage Ferro-Titanium for Cast Iron and Cast Steel (Versuche mit Ferro-Titan-Thermit und niedrigprozentigem Ferro-Titan für Gusseisen und Stahlformguss). Leonhard Trenheit. A report of tests of the effect of titanium on the strength of iron and steel castings. Ills. 7000 w. Stahl u Eisen—July 13, 1910. No. 16578 D.

Inspection.

Organizing an Inspection Department in an Engineering Works. H. Graham. Suggestions for the inspection department of works where accuracy is important. Ills. 2000 w. Prac Engr—Aug. 12, 1910. No. 16493 A.

Metallography.

A New Metallographic Microscope. William Campbell. Illustrated detailed description. 800 w. Sch of Mines Qr—April, 1910. No. 16479 D.

The Artificial Reproduction of the Widmanstätten Structure in Carbon Steel (Sur la Reproduction artificielle de la Structure de Widmanstätten dans l'Acier au Carbone) Nicolas Belaiew. Illustrates results of attempts to produce the structure observed by Widmanstätten in meteorites in alloy steels. 3000 w. Rev de Mètal—July, 1910. No. 16517 E + F.

Steel.

A Research on the Hammer-Hardening of Steel and Industrial Metals (Expériences sur l'Ecrouissage de l'Acier et des Métaux industriels). F. Robin. Gives results and conclusions of a physical and microscopic investigation. Ills. 7500 w. Mem Soc Ing Civ de France—June, 1910. No. 16507 G.

Hammer-Hardening (Remarques sur l'Ecrouissage). Léon Guillet. Comments on M. Robin's paper and on previous researches. Ills. 4500 w. Mem Soc Ing Civ de France—June, 1910. No. 16508 G.

See also Locomotive Construction, under RAILWAY ENGINEERING, Motive Power and Equipment.

MEASUREMENT.

Dynamometers.

An Improved Absorption Dynamometer. Discussion of Prof. C. M. Garland's paper. 700 w. Jour Am Soc of Mech Engrs—Aug., 1910. No. 16297 F.

Elastic Limit.

Elastic Limit by Temperature. Translated extract from a paper by E. Rasch describing a useful application of the principle that when material is stretched it becomes colder and when released again rises to normal. 600 w. Am Mach—Vol. 33, No. 32. No. 16277.

Hardness.

The Hardness Testing of Cast Iron. Richard Mather. Read before the British Found. Assn. Refers briefly to Turner's, Keep's, and Brinnell's tests, and describes the Shore scleroscope. 2000 w. Mech Engr—Aug. 12, 1910. No. 16496 A.

Hardness Tests on Alloys of Nickel and Copper with Electrolytic Iron. G. A. Roush. Reports on investigation for determining the hardness, using the scleroscope method devised by Albert F. Shore in 1906. 1700 w. Met & Chem Engng—Aug., 1910. Serial. 1st part. No. 16115 C.

Load Meter.

A Load Meter for Piston Engines Working under Variable Load (Leistungszähler für Kolbenmaschinen mit beliebig veränderlicher Belastung). Anton Böttcher. Describes the theory and construction of a device designed by the author. Ills. 6000 w. Zeitschr d ver Deutscher Ing—July 23, 1910. No. 16788 D.

Pitot Tubes.

Rating of Pitot Tubes. H. C. Berry. Describes the methods employed in rating the tubes used in the measurement of the quantity of water passing into the penstocks of the Ontario Power Co. Ills.

Discussion. 10000 w. Pro Engrs Club of Phila—July, 1910. No. 16393 D.

Pressure Gauges.

Two-Liquid Differential Gauge. Jas. Alex. Smith. Illustrated description of a simple, sensitive, two-liquid gauge for measuring small pressures, giving some applications. 1600 w. Engng—July 22, 1910. No. 16147 A.

The Accuracy of Spring Pressure Gauges (Der Genauigkeitsgrad der Federmanometer). G. Klein. Records a number of tests of gauges of this type. Ills. 3500 w. Zeitschr d Ver Deutscher Ing—July 30, 1910. No. 16792 D.

Pyrometry.

Recent Advances in Pyrometry. R. S. Whipple. Discusses gas thermometry, resistance thermometry, thermo-electric pyrometry, and radiation pyrometry, describing recent developments in each. 3000 w. Elect'n, Lond—July 22, 1910. No. 16128 A.

The Pyrometer, Its Development and Use. William H. Bristol. Reviews the history of various types, discussing their use in the laboratory and the necessity for more sturdy instruments for practical work, and describes the Bristol type of instrument. 1800 w. Automobile—Aug. 4, 1910. Serial. 1st part. No. 16181.

Measurement of High Temperatures. A. R. Maujer. Illustrates and describes six different types of pyrometers for boiler plant use. 2400 w. Power—Aug. 2, 1910. No. 16070.

Vulgarized Pyrometry. Marius C. Krarup. Explains how the heat of steel may be measured accurately by improved methods for color comparison. 1800 w. Automobile—Aug. 18, 1910. No. 16449.

Selecting and Using Pyrometers. C. Conam. Considers thermocouple and resistance types. 1200 w. Power—Aug. 30, 1910. No. 16734.

Units.

The Horse-Power. H. M. Phillips. Discusses general notions of power development and measurement. 3500 w. Cassier's Mag—Aug., 1910. No. 16292 B.

Wind Pressures.

The Eiffel Aero-Dynamometric Installation. Illustrates and describes the apparatus installed near the Tour Eiffel for procuring data concerning wind pressures, and the method of experimenting. 2000 w. Engr, Lond—Aug. 5, 1910. No. 16357 A.

POWER AND TRANSMISSION.

Air Compressors.

Single-Stage Single-Acting Air-Compressor. Illustrates and describes a new English design. 1200 w. Engng—July 22, 1910. No. 16141 A.

Belt Driving.

Belt Design Notes and Diagrams. William Manktelow. Gives diagrams with explanation of their use. 1000 w. Mech Wld—Aug. 19, 1910. No. 16700 A.

Cork Inserts for Automobile-Making Machinery. Lawrence Whitcomb. Read at meeting of Soc. of Auto. Engrs. Shows their value in eliminating losses in power transmission, their applications and the results. 1500 w. Automobile—Aug. 4, 1910. No. 16179.

Costs.

The Cost of Steam Power in a Mill Plant. Howard S. Knowlton. Gives results of a test in a large mill plant which was maintained 14 continuous days and nights. 1800 w. Eng Rec—Aug. 13, 1910. No. 16328.

Electric Driving.

Steam Engine vs. Motor Drive for Small Machine Shops. A. G. Popcke. Showing the advantages of the motor drive by a comparison of the two systems. 2000 w. Elec Jour—Aug., 1910. No. 16385.

Symposium on Electric Driving in Machine Shops. Discussion of the papers presented by A. L. DeLeeuw, Charles Fair, Charles Robbins, and John Riddell. Ills. 13000 w. Jour Am Soc of Mech Engrs—Aug., 1910. No. 16300 F.

Lubricants.

Necessary Reform in Specifications for Petroleum Products. Dr. Albert Sommer. Presented before the Am. Soc. for Test. Mat. Shows that reforms are an urgent necessity, with suggestions. 4000 w. Eng Rec—Aug. 6, 1910. No. 16222.

Lubricants for Automobiles (Die Schmiermittel und ihre Bedeutung für den Fahrbetrieb). G. Wolff. Discusses the properties of various lubricants, with special reference to their use in motor cars. 5000 w. Zeitschr d Mit Motorwagen Ver—July 31, 1910. No. 16754 D.

Parallel Operation.

The Behavior of Prime Movers in Mechanical or Electrical Parallel Operation (Ueber das Verhalten von Kraftmaschinen im mechanischen oder elektrischen Parallelbetrieb). Otto Ohnesorge. A general consideration of the problem of parallel operation. Ills. 2600 w. Zeitschr d Ver Deutscher Ing—July 30, 1910. No. 16790 D.

Rope Driving.

The Design of Rope Drives. Francis H. Davies. Discusses the influences of length and angle of drive, form of groove, ratio of pulley diameters, speed, size and character of rope. Ills. 2500 w. Power—Aug. 16, 1910. No. 16374.

Shaft Bearings.

Ball-Bearing Lineshaft-Hangers. Discussion of paper by Henry Hess. 2500 w. Jour Am Soc of Mech Engrs—Aug., 1910. No. 16296 F.

Shafting.

The Erection of Machine-Shop Shafting. George W. Burley. Discusses the

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arrangement of the machines and shafting, methods of fixing the position of shafting and hangers, supporting hangers, etc. Ills. 2500 w. Mech Wld—July 29, 1910. Serial. 1st part. No. 16245 A.

STEAM ENGINEERING.

Boiler Draft.

Balanced Draft in Steam-Boiler Practice (Un nouveau Mode de Fonctionnement économique des Foyers de Générateurs à Vapeur et autres Réalisé par le "Tirage équilibré"). Serge Heryngfet. Describes the system, discusses its economy, and reports tests. Ills. 8800 w. Mem Soc Ing Civ de France—May, 1910. No. 16505 G.

Boiler Efficiency.

Air Supply and Boiler Efficiency. A. B. McIntyre. Gives method of figuring furnace temperature due to complete combustion; also loss due to incomplete combustion because of insufficient air supply. 3000 w. Power—Aug. 30, 1910. No. 16733.

Fire and Water Tube Boilers. William Westerfield. Shows that soot does not affect the efficiency of one more than the other. Ills. 1200 w. Power—Aug. 23, 1910. No. 16471.

Boiler Explosions.

Boiler Explosions and Their Causes. G. W. Buckwell. Read before the Barrow & District Assn. of Engrs. Discusses the various theories that have been advanced to account for explosions, and gives a review of a number of explosions and their causes. 4500 w. Mech Wld—July 29 & Aug. 5, 1910. 2 parts. No. 16349, each A.

A Remarkable Explosion. An illustrated account of the explosion in the s. s. Anglo-Saxon on the 31st of Dec., 1909, when the ship was off Cape Palliser, New Zealand. 700 w. Engr, Lond—Aug. 12, 1910. No. 16606 A.

Boiler Firing.

Economical Fire Room Methods. F. R. Low. Illustrated account of a hand-fired plant in which some remarkable results were obtained. 3000 w. Power—Aug. 2, 1910. No. 16069.

Boiler Fittings.

A New Feed-Water Regulator. Illustrated detailed description of the Crosby regulator. 1200 w. Engr, Lond—Aug. 12, 1910. No. 16605 A.

Boiler Management.

The Selection, Use and Abuse of Steam Boilers. Byron Cummings. From an address at York, Pa., before the Mrfs.' Assn. Refers to boilers and plants of size used by the average manufacturer. Ills. 6500 w. Boiler Maker—Aug., 1910. No. 16265.

Boiler Rating.

Testing Heating Boilers. An illustrated account of how a cast iron boiler was studied under conditions intended to fix the proper rating. 3000 w. Met Work—Aug. 20, 1910. No. 16447.

Boilers.

The Nesdrum Water-Tube Boiler. Illustrated description. 500 w. Mech Engr—July 29, 1910. No. 16244 A.

De Naeyer's Boilers with Underfeed Stokers at the Brussels Exhibition. Illustrated description. 1000 w. Engng—Aug. 5, 1910. No. 16354 A.

The Present Status of the Sectional Boiler Industry (Der gegenwärtige Stand der Gliederkesselindustrie). Herr Pradel. Describes and discusses various types of sectional heating boilers. Ills. 6000 w. Zeitschr d Ver Deutscher Ing—July 23, 1910. No. 16787 D.

Boiler Troubles.

Grooving in Steam Boilers. W. H. Booth. Explains the cause of grooving and how it may be avoided. 1200 w. Power—Aug. 16, 1910. No. 16376.

Boiler Tubes.

The Influence of Eddy Rings on Boiler Efficiency (Einfluss der Wirbelringe auf den Nutzeffekt der Kessel). Carl Züblin. Describes tests of boilers equipped with the Pielock eddy rings. Ills. 2000 w. Schiffbau—July 13, 1910. No. 16593 D.

Boiler Waters.

The Examination of Water by Electrical Methods. W. Pollard Digby. Illustrates and describes a conductivity tube devised for every day engineering work, giving details of tests. 2500 w. Elect'n, Lond—July 29, 1910. No. 16240 A.

Condensers.

Condensers for Small Central Stations. Charles S. Lewis. Read before the Missouri Elec. Gas, St. Ry. & W.-Wks. Assn. Explains the effect of vacuum on the steam consumption of various types of prime movers, and describes recent improvements and their effect in securing higher vacua. Ills. 2000 w. Ir Age—Aug. 11, 1910. No. 16270.

Condensing Water Arrangements. Considers briefly cooling ponds, cooling towers, and the general principles underlying the choice of condensers under various conditions. Ills. 2000 w. Prac Engr—Aug. 5, 1910. Serial. 1st part. No. 16344 A.

Engine Balancing.

The Balancing of Reciprocating Engines. R. J. Grimshaw. Investigates methods of equalizing disturbing forces. Diagrams. 2500 w. Cassier's Mag—Aug., 1910. No. 16291 B.

Engines.

Corliss Engine with Two Eccentrics. R. C. Heck. Discusses the advantage of operating the steam and exhaust-valves by separate eccentrics. Ills. 1200 w. Power—Aug. 16, 1910. No. 16373.

Flue Gas Analysis.

Flue Gas Analysis and Calculation. Julian C. Smallwood. Briefly discusses

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the molecular theory, shows how to compute the amount of air required to burn a pound of carbon, and how to determine heat losses 2500 w. Power—Aug. 9, 1910. No. 16260.

Fuel Testing.

The Acid Specific-Gravity Test. A. Langerfeld. Information concerning the amount of impurities allowed in the various sizes of anthracite, and the methods of testing for them. 4500 w. Mines & Min—Aug., 1910. No. 16099 C.

Fuels.

Some Considerations on the Fuel Question. G. Basil Barham. Economies in central stations are discussed, especially the use of cheaper fuel and the furnaces for burning them. 2000 w. Elec Rev, Lond—July 29, 1910. No. 16235 A.

Calculating Heat Value of Coal. Julian C. Smallwood. Shows how to calculate the amount of air required to burn a pound of coal based either on approximate or ultimate analysis. Also how to determine the heat value. 5000 w. Power—Aug. 23, 1910. No. 16469.

Heat Transmission.

The Relation between Heat Transmission and Length of Pipe (Die Abhängigkeit der Wärmeübergangszahl von der Rohrlänge). Wilhelm Nusselt. Mathematical. Ills. 5000 w. Zeitschr d Ver Deutscher Ing—July 9, 1910. No. 16783 D.

Rotary Engines.

The Motsinger Rotary Engine. Illustrated description of a three-rotor model combining two engines in one. 2500 w. Ir Age—Aug. 4, 1910. No. 16159.

Smoke Prevention.

The New Smoke Law, Boston. Howard S. Knowlton. A report of the investigation made by the Chamber of Commerce and the bill passed, stating the main provisions of the act. 2300 w. Eng Rec—Aug. 6, 1910. No. 16216.

Steam Accumulators.

A New Regenerative Accumulator. Sectional elevation, plan and description of a patent regenerative accumulator for intermittent steam supply, from high-pressure engines for low-pressure turbines. 1000 w. Ir & Coal Trds Rev—Aug. 12, 1910. No. 16609 A.

Steam Pipes.

Water in Steam May Cause Trouble. W. H. Booth. Describes the action of water in steam and suggests how it may be avoided. 1200 w. Power—Aug. 23, 1910. No. 16468.

Turbine Design.

Dimensions of Steam Turbines. Charles A. Edmonds. Illustrated discussion of the preliminary calculations forming the basis of turbine designs, and cites current practice in dimensioning parts. 3000 w. Power—Aug. 9, 1910. No. 16259.

High-Speed Steam-Turbine Rotor Design and Construction. John McKenzie Newton. Read before the Jun. Inst. of Engrs. Discusses chiefly the mechanical strength and stiffness in relation to the materials of construction. Ills. 3500 w. Mech. Engr—July 22, 1910. No. 16137 A.

Turbine Operation.

Some Features of Steam-Turbine Operation (Etude de quelques Points particuliers du Fonctionnement des Turbines à Vapeur). C. Monteil. Discusses axial pressure, and the laws of mechanical similitude in steam turbines. Ills. 8000 w. Mem Soc Ing Civ de France—June, 1910. No. 16509 G.

Turbine Packings.

On the Theory of Labyrinth Packing. J. Morrow. Read before the Ap. Sci. Sec. of the Univ. of Durham. Gives a method of calculating the leakage in steam-turbine packings. 700 w. Engng—July 22, 1910. No. 16144 A.

Turbines.

Present Steam Turbine Progress. Edwin D. Dreyfus. An illustrated discussion of types and developments in turbines, special features of design, operating conditions, performance, applications, etc. 3500 w. Pro Ry Club of Pittsburgh—May 20, 1910. No. 16381 C.

High Speed Steam Turbines. Edwin D. Dreyfus. Considers changes resulting from the adoption of increased speed ratings. Ills. 1200 w. Elec Jour—Aug., 1910. No. 16384.

A New Steam Turbine. Illustrates and describes turbines manufactured by Franco Tosi, Legnano. 2000 w. Engr, Lond—July 22, 1910. No. 16148 A.

Turbine Tests.

Test of a 15000-K. W. Steam-Engine-Turbine Unit. H. G. Stott and R. J. S. Pigott. Addition to paper, with discussion. Ills. 10000 w. Jour Am Soc of Mech Engrs—Aug., 1910. No. 16295 F.

TRANSPORTING AND CONVEYING.

Cableways.

A Study of Aerial Ropeways (Etude sur les Cables Transporteurs aériens). M. M. Thiery and Cretin. A complete study of their design and construction. Ills. Serial. 1st part. 4500 w. Rev de Mécan—July, 1910. No. 16523 E + F.

Conveyors.

Travelling Dredger Elevator at Shieldhall Sewage Works, Glasgow. Illustrated detailed description of an appliance for the removal of solid matter and mud carried into the catchpit. 800 w. Engr, Lond—July 22, 1910. No. 16149 A.

Cranes.

Electric Locomotive Jib-Crane for Block-Setting. Illustrated description of a crane intended for use either for block-setting or drop-bottom bucket. 500 w. Engng—July 22, 1910. No. 16143 A.

An Eight-Ton Crane Locomotive. Illustrated description. 300 w. Engr, Lond—Aug. 19, 1910. No. 16721 A.

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36-Ton Steam Locomotive Breakdown Crane. Illustrated description of a wrecking crane designed to meet difficult conditions. 600 w. Engng—Aug. 5, 1910. No. 16356 A.

Plate-Handling Plant for Shipyards. Illustrated description of an electrically operated, semi-automatic plant recently installed at Newcastle. 1400 w. Ir & Coal Trds Rev—Aug. 19, 1910. No. 16724 A.

Cranes for Railway Service (Grane, insbesondere solche für Eisenbahnbetriebe). Herr Schrader. Describes various types of cranes for construction, wrecking, loading and unloading, and shop purposes. Ills. 4000 w. Glasers Ann—July 15, 1910. No. 16752 D.

Freight Handling.

Clearing House for Goods in London. An illustrated account of the means proposed by A. W. Gattie and A. G. Seaman for the handling and sorting of goods and parcels mechanically. 3500 w. Elect'n, Lond—July 22, 1910. No. 16127 A.

Ore Handling.

Material-Handling Machinery and Its Evolution. E. H. Messiter. A review of the development of such appliances. 1500 w. Min & Sci Pr—July 30, 1910. No. 16183.

MISCELLANY.

Aeronautics.

Recent Aeronautic Competitions (Les récentes Epreuves Aéronautiques). Describes and gives the results of the meet at Rheims, July 3 to 10, 1910. Ills. 8000 w. Génie Civil—July 16, 1910. No. 16548 D.

A Simple Explanation of the Principles Involved in the Wright Patent Suit. Ills. 2000 w. Sci Am—Aug. 13, 1910. No. 16283.

The Figures Behind the Aeroplane. Warren H. Miller. Enumerates the laws of planes moving in air, and of increasing proportions, and gives tabulated data of successful machines. 3000 w. Am Mach—Vol. 33. No. 31. No. 16165.

Industrial Aeroplanes. Marius C. Krarup. Gives improved designs of aeroplanes for securing equilibrium and some new details of construction. Ills. 2000 w. Automobile—Aug. 18, 1910. Serial. 1st part. No. 16450.

Aeroplanes in Naval Warfare (I velivoli nella Guerra navale). Claudio Piumatti. A consideration of their possible usefulness. Ills. 5500 w. Riv Marit—July-Aug., 1910. No. 16555 E + F.

Joseph Michel Montgolfier, a Centenary Study (Joseph Michel Montgolfier, Zum hundertsten Wiederkehr seines Todestages am 28 June, 1810). Dr. Keller. A sketch of the life and work of the inventor of the balloon. Ills. 6600 w. Zeitschr d Ver Deutscher Ing—July 2, 1910. No. 16780 D.

Ordinary and Dirigible Balloons (Palloni ordinari e dirigibili). E. Forlanini. A general historical and technical review. Ills. Serial. 1st part. 1300 w. Industria—July 24, 1910. No. 16568 D.

The Technology of Dirigibles (La Technique des Dirigeables). Capitaine Do. Discusses the general conditions of the problem, the difficulties presented, and the various solutions attempted. Ills. 10500 w. Tech Mod (Sup.)—July, 1910. No. 16527 D.

The Parseval Airship. Carl Dientsbach. Illustrated detailed description of this airship and its handling. 2500 w. Sci Am—Aug. 13, 1910. No. 16282.

Agricultural Machinery.

See also Tactics, under AUTOMOBILES.

Calculating Machines.

The Ellis Adding Typewriter. Ralph E. Flanders. Illustrates and describes the principle of the adding and mechanism and its application to a new type of machine. 7000 w. Mach, N Y—Aug., 1910. No. 16102 C.

Clocks.

Two Remarkable Old English Clocks. F. A. Halsey. Illustrated description of timepieces 600 years old, one of which is still at work. 900 w. Am Mach—Vol. 33. No. 33. No. 16420.

Guns.

Vickers' Ordnance at the Japan-British Exhibition. Plates, illustrations and description of the exhibits. 4500 w. Engng—Aug. 12, 1910. No. 16600 A.

MINING AND METALLURGY.

COAL AND COKE.

Accidents.

Coal-Cutting Machinery and Electrical Accidents in Mines. Information from the report of H. M. Inspectors of Mines for the year 1909, showing progress in use of electrically-driven machinery, the accidents and precautions necessary. 1500 w. Elec Rev, Lond—Aug. 5, 1910. Serial. 1st part. No. 16341 A.

Alaska.

The Bering River Coalfield of Alaska. L. W. Storm. Map and description of this field, the quality of the coal, and discusses the importance of its development. 2700 w. Eng & Min Jour—Aug. 6, 1910. No. 16212.

Alberta.

The Galt Coalfield, Alberta. W. D. L. Hardie. Brief description. 1000 w. Ir &

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Coal Trds Rev—Aug. 12, 1910. No. 16608 A.

Briquetting.

The Manufacture of Coal Briquettes. A. R. Maujer. Illustrates and describes the equipment of a plant for manufacturing briquettes from anthracite dust. 1000 w. Power—Aug. 23, 1910. No. 16467.

Coke Ovens.

The Collin Regenerator By-Product Coke Oven. Illustrated description of a successful German type recently introduced in the United States. 1500 w. Ir Age—Aug. 4, 1910. No. 16158.

The Koppers By-Product Coke Oven and Direct Ammonia Recovery Process. Illustrates and describes a modern process for lowering the cost and reducing time of production. Plate. 2000 w. Ir Trd Rev—Aug. 11, 1910. No. 16304.

Coking.

The Tendencies of Modern Coking Practice. Ernest Bury. Discusses the by-product coking industry, comparing processes. 5000 w. Col Guard—Aug. 5, 1910. No. 16351 A.

Coking By-Products.

By-Product Ovens in America and Europe. F. E. Lucas. A comparison of practice at plants operated in connection with iron and steel works. 1500 w. Ir Age—Aug. 18, 1910. No. 16434.

Progress in the Recovery of Coking By-Products (Ueber die Fortschritte in der Gewinnung der Nebenprodukte beim Kokereibetriebe). O. Rau. Read at the Düsseldorf Congress. A review of the development of by-product coking in Europe. Serial. 1st part. 10000 w. Stahl u Eisen—July 20, 1910. No. 16580 D.

Electric Power.

Earthed and Insulated Neutrals in Colliery Work. Abstract of a paper by W. Wellesley Wood before the British Inst. of Elec. Engrs., discussing the principal advantages of the respective systems. 1000 w. Eng & Min Jour—Aug. 6, 1910. No. 16213.

England.

Re-Survey of the Derbyshire and Nottinghamshire Coalfield. Information from the last report of the Progress of the Geological Survey of Great Britain, relating to the coal measures. 2000 w. Ir & Coal Trds Rev—Aug. 19, 1910. No. 16727 A.

Explosions.

Some Simple Experiments to Illustrate the Propagation of Explosions in Non-Detonating Explosive Gaseous Mixtures. G. R. Thompson. Read before the Midland Inst. of Min., Civ. and Mech. Engrs. Describes recent investigations. 2800 w. Ir & Coal Trds Rev—Aug. 5, 1910. No. 16363 A.

The Mulga Mine Explosion. Explains conditions and probable cause of an explosion in Alabama. Ills. 1500 w. Mines & Min—Aug., 1910. No. 16096 C.

Explosives.

Gaseous Decomposition-Products of Black Powder, with Special Reference to the Use of Black Powder in Coal-Mines. Clinton M. Young. Describes experiments carried on in 1908-9 by the State Geological Survey of Kansas. 7500 w. Bul Am Inst of Min Engrs—Aug., 1910. No. 16410 F.

Germany.

The Future of the German Coal Industry. Discusses the question of the Coal Syndicate, and present conditions. 2000 w. Ir & Coal Trds Rev—Aug. 19, 1910. No. 16725 A.

Illinois.

The Illinois Coal Field. H. H. Stoek. Reviews the history and discusses the geology, trade, inspection, and mining districts. Map. 4000 w. Mines & Min—Aug., 1910. No. 16097 C.

Mine Accounting.

Colliery Book-Keeping and Accounts. George Johnson. Detailed explanation of methods used. 2500 w. Ir & Coal Trds Rev—Aug. 5, 1910. Serial. 1st part. No. 16364 A.

Mine Air.

Variations of Atmospheric Pressure and the Methane Content of Pit Air. Abstract translation from *Zeit. fur das Berg-, Hutten- und Salinenwean.* Report of experimental investigations. 1000 w. Compressed Air—Aug., 1910. No. 16403.

Mine Dust.

Coal Dust Experiments at the Experimental Gallery of the Rossitz Coalfield. Dr. Czaplinski and J. Jicinsky. Trans. from *Oesterreichische Zeit. fur Berg- und Hüttenwesen.* Experimental study of the explosibility. 1700 w. Ir & Coal Trds Rev—July 22, 1910. No. 16155 A.

Mine Fires

Recollections of Mine Fires. William Crosley. Recollections of the Pemberton colliery explosion in 1877, and the Abbontiakoon mine in 1905. 2000 w. Mining Mag—Aug., 1910. No. 16639 B.

Mine Gas.

The Cunynghame-Cadman Firemen's Lamp. Illustrated description of a lamp for testing the safety of a mine atmosphere. 1000 w. Engng—July 22, 1910. No. 16145 A.

Mining Plants.

Engineering of Modern Coal Plants. Howard N. Eavenson. Read before the W. Va. Min. Inst. Describes the plants of the United States Coal & Coke Co. 4500 w. Mines & Min—Aug., 1910. No. 16098 C.

A Model Coal Mining Plant in Wyoming. Henry M. Payne. Illustrated description of the equipment and methods of the Superior Coal Co. 1500 w. Eng & Min Jour—July 30, 1910. No. 16068.

Peat.

The Exploitation of the Peat Bogs of

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Canada. Eugene Haanel. An address at Ottawa on the development of the extensive peat deposits. 3000 w. Prac Engr—Aug. 19, 1910. No. 16694 A.

Refuge Chambers.

Refuge Chambers in Coal Mines. George S. Rice. Reviews the Cherry disaster and discusses the construction of refuge chambers and the cost. Ills. 4000 w. Eng & Min Jour—Aug. 27, 1910. No. 16677.

The Employment of Mine Refuge Chambers (Emploi des Chambres de Sureté dans les Mines). Ch. Marquet. Discusses their disposition, construction and arrangement, and use. Ills. 2400 w. Mem Soc Ing Civ de France—May, 1910. No. 16504 G.

Rescue Stations.

New Rescue Station in South Wales. Illustrations and brief description of the new station at Crumlin, recently opened. 300 w. Col Guard—Aug. 12, 1910. No. 16499 A.

Tipples.

Modern Methods in a Coal Tipple. Henry Harrison. Illustrates and describes the Empire Tipple in W. Va., and the methods of treatment. 3000 w. Eng & Min Jour—Aug. 20, 1910. No. 16466.

Wales.

The Eastern Development of the North Wales Coalfield. Sketch plan and description of the extension, with report of uncompleted work. 1500 w. Col Guard—Aug. 5, 1910. No. 16352 A.

COPPER.

Australia.

Notes on the Geology of Mount Morgan, Queensland. J. M. Newman and G. F. Campbell Brown. Read before the Aust. Inst. of Min. Engrs. Ills. 4000 w. Queens Gov Min Jour—July 15, 1910. No. 16730 B.

Blast Furnaces.

Circular Copper Blast Furnaces. Thomas E. Lambert. Illustrated comparison of forms of furnaces used for smelting iron and copper ores. 4000 w. Mines & Min—Aug., 1910. No. 16094 C.

Converter Lining.

Basic Lined Converters for Leady Copper Matter. Radick R. Moore. Reports basic linings successful under careful operation. 2000 w. Eng & Min Jour—Aug. 6, 1910. No. 16209.

Mexico.

Ore Deposits of Cananea Mining District, Mexico. S. F. Emmons. Describes three types of ore deposits and gives information concerning the geology, the production, etc. Map. 2000 w. Eng & Min Jour—Aug. 27, 1910. No. 16672.

Minnesota.

Keweenowan Copper Deposits. Frank F. Grout. A study of the source of the copper. 2000 w. Ec-Geol—July-Aug., 1910. No. 16294 D.

Newfoundland.

The Mineral Resources of Newfoundland. Breaton Symons. Describes the general geology, reporting deposits of copper, hematite, and pyrite, the development, and information relating to mining. Map. 3500 w. Eng & Min Jour—Aug. 20, 1910. No. 16464.

New Mexico.

The Chino Copper Property, New Mexico. C. A. Dinsmore. Illustrates and describes the work in progress at these copper mines. 2000 w. Min Wld—Aug. 27, 1910. No. 16683.

Quebec.

Early Copper Mining in the Province of Quebec. James Douglas. An interesting review of the history of its development. 5000 w. Can Min Jour—Aug. 1, 1910. No. 16077.

Smelter Fumes.

The Condensation of Fume and the Neutralization of Furnace-Gases. F. T. Havard. Reviews the history of the condensation of fume, describing methods used in condensing fume and in de-acidifying furnace-gases. 6000 w. Bul Am Inst of Min Engrs—Aug., 1910. No. 16407 F.

Smelting.

Mining and Smelting Plant of Mond Nickel Co. Grant B. Shipley. Illustrated description of a reconstructed copper-nickel plant using electric power. 3000 w. Eng & Min Jour—Aug. 20, 1910. No. 16465.

The Yampa Smelter at Bingham. Leroy A. Palmer. Describes the process by which low grade copper ore is smelted. Ills. 6000 w. Mines & Min—Aug., 1910. No. 16093 C.

GOLD AND SILVER.

Alaska.

Placer Mining Operations in Alaska in 1909. Alfred H. Brooks. Information concerning the last year's work, the production, etc. Maps. 3000 w. Eng & Min Jour—Aug. 27, 1910. No. 16675.

Assaying.

Labor-Saving Appliances in the Assay-Laboratory. Edward Keller. Supplementary to the earlier paper. Illustrates and describes devices for working in sets. 600 w. Bul Am Inst of Min Engrs—Aug., 1910. No. 16409 F.

Australia.

Dredge Mining and Hydraulic Sluicing in 1909. D. B. Sellars. A review of the plants in New South Wales. 2000 w. Aust Min Stand—June 22, 1910. No. 16122 B.

The Deserted Reefs of Castlemaine (V.). Reviews the history and describes the district. 3500 w. Aust Min Stand—July 20, 1910. No. 16728 B.

Notes on the Great Fitzroy Mines, Limited. J. Adam. Read before the Aust. Inst. of Min. Engrs. Describes deposits

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worked for gold and silver, the geology, workings, sampling, etc. 1800 w. Queens Gov Min Jour—July 15, 1910. No. 16731 B.

Chlorination.

Electrolytic Chlorine at Mt. Morgan, Queensland. B. Du Faur. Illustrated detailed description of this plant and its operation. 3500 w. Aust Min Stand—June 22, 1910. No. 16120 B.

Cobalt.

See also Hydro-Electric, under ELECTRICAL ENGINEERING, GENERATING STATIONS

Cyaniding.

The Destruction of Cyanide. James Moir and Jas. Gray. An account of experiments which contradict practically everything that is to be found in the text-books on the ferro-cyanide reaction. Also a criticism and report of experiments by H. A. White. 10800 w. Jour Chem, Met & Min Soc of S Africa—June, 1910. No. 16485 E.

Notes on the Cyanidation of Concentrates. Herbert A. Megraw. Brief discussion of various methods of treatment. 2200 w. Min Wld—Aug. 13, 1910. No. 16368.

Cyaniding at the North Star Mines in California. John Tyssowski. Describes the cyaniding of mill tailings and concentration, claiming high extraction. Ills. 2500 w. Eng & Min Jour—Aug. 27, 1910. No. 16674.

Continuous Agitation System at Esperanza. M. H. Kuryla. Describes the present continuous system at El Oro, Mexico, and the equipment. 800 w. Eng & Min Jour—July 30, 1910. No. 16065.

Reconstruction of the Angustias Cyanide Mill. Herbert A. Megraw. Illustrates and describes a plant in Mexico. The mill was built for the patio process. A 50-ton cyanide plant has been installed. 2000 w. Eng & Min Jour—Aug. 13, 1910. No. 16333.

Dredging.

Gold Dredging Operations in Montana. J. P. Rowe. Describes the various properties being worked, illustrating the dredges used. 3000 w. Min Wld—Aug. 27, 1910. No. 16682.

Germany.

The St. Andreasberg Silver Deposits (Die Silbererzgänge von St. Andreasberg i. H.). Herr Werner. Read at the Düsseldorf Congress. Illustrated description of these German deposits. Serial. 1st part. 5500 w. Glückauf—July 16, 1910. No. 16589 D.

Korea.

Gold Mining in Korea, 1910. J. D. Hubbard. Brief review of the work of various companies. Ills. 2500 w. Min & Sci Pr—Aug. 20, 1910. No. 16648.

Mexico.

Conditions at the Palmilla Mine, Parral, Mexico. Franklin W. Smith. Reviews the history of the property, describing the ore deposits and their development. Ills. 3000 w. Eng & Min Jour—Aug. 6, 1910. No. 16208.

Montana.

East Coeur d'Alene Mining District, Montana. Harry A. Moore. An illustrated account of this district and its development, describing the mining properties and the copper, lead, silver, and gold zones. 4500 w. Min Wld—Aug. 13, 1910. No. 16370.

Ontario.

Geology of the Porcupine Gold Fields Defined. Alex. Gray. Describes the topography and geology, the important rocks, ore bodies, etc., of this Ontario region. Map. 4500 w. Min Wld—Aug. 13, 1910. No. 16369.

The Gold District of Wabigoon Lake, Ontario. R. B. Brinsmade. Illustrated account of the geology and development of mining properties. 2000 w. Min Wld—Aug. 6, 1910. No. 16223.

Precipitation.

Experiments on the Precipitation of Gold from Cyanide Solution by Carbon in Lime. Edward H. Croghan. A report of experimental investigations. 2000 w. Jour Chem, Met, & Min Soc of S Africa—May, 1910. No. 16119 E.

Rand.

Possibilities of Deep Mining in the Transvaal. Rowland Gascoyne. Discusses the possibilities and the difficulties. 2500 w. Min Wld—Aug. 20, 1910. No. 16456.

Rand Mine Returns, with Special Reference to the New Fathomage System. W. W. Mein. Explains and defends established tonnage methods and criticizes the proposed reform. 11000 w. Jour S African Assn of Engrs—May-June, 1910. No. 16336 F.

IRON AND STEEL.

Bessemer Process.

An Experimental Analysis of the Basic Bessemer Process (Analyse expérimentale du Procédé Thomas). Marius Picard. A discussion based on the researches of Wüst and Laval, reported in Stahl u Eisen for Jan. 27, 1909. Ills. Serial. 1st part. 5000 w. Tech Mod—July, 1910. No. 16529 D.

Blast Furnace Charging.

The Mechanical Charging of Blast Furnaces. Edgar J. W. Richards and Thomas Lewis. Read before the Cleveland Inst. of Engrs. Abstract. Discusses types of chargers, particularly the inventions of the authors. Ills. 3500 w. Ir & Coal Trds Rev—Aug. 5, 1910. No. 16362 A.

Blast-Furnace Gas.

Boiler Firing with Blast-Furnace Gas and an Automatic Gas-Burning Apparatus (Ueber Versuche rationeller Hochofen-Kesselheizung und Beschreibung eines

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automatisch wirkenden Gasbrennapparates bei der Hüttenindustrie). Gustav Oelwein. Describes the equipment of a plant at Trynietz, Austria. Ills. Serial. 1st part. 3000 w. Oest Zeitschr f Berg- u Hüttenwesen—July 9, 1910. No. 16586 D.

Blast-Furnace Practice.

Agglomeration of Manganiferous Limonite Ore. F. Witte. Abridged translation from *Stahl u. Eisen.* Describes the ores and the treatment. 1500 w. Eng & Min Jour—July 30, 1910. No. 16666.

Blowers.

The Economy of Various Working Methods of Driving Blowing Engines in Steel Works. Herr Mauritz. Abstract of a paper read before the Int. Cong. at Dusseldorf. Shows that blast furnace gas is capable of supplying all requirements for power, and have still some power left in reserve. 3000 w. Ir & Coal Trds Rev—July 22, 1910. No. 16153 A.

Brazil.

Brazil's Iron-Ore Deposits. Reports large amounts of high-grade ores as yet undeveloped, awaiting means of transportation. 3500 w. Mines & Min—Aug., 1910. No. 16091 C.

California.

Future Pig-Iron Production in California. A. H. Martin. Discusses the prospect for the development of important iron mining and smelting districts. 2000 w. Min Wld—Aug. 27, 1910. No. 16684.

Case Hardening.

See same title, under MECHANICAL ENGINEERING, MACHINE WORKS AND FOUNDRIES.

Electro-Metallurgy.

Electric Smelting of Iron Ore at Heroult, Cal. John Tyssowski. Illustrates and describes this electric iron-smelting plant. 3000 w. Eng & Min Jour—Aug. 6, 1910. No. 16211.

France.

The Iron-Ore Resources of France (Les Ressources de la France en Minerals de Fer). From the "Iron Ore Resources of the World," a report compiled by the Bureau of the Eleventh International Congress of Geology. Ills. 4000 w. Génie Civil—July 2, 1910. No. 16545 D.

Hot-Blast Stoves.

The Design and Heating Power of Hot-Blast Stoves (Berechnung und Wärmeausstrahlung steinerner Winderhitzer). Chr. Aldendorff. A criticism of Osann's paper in *Stahl und Eisen* for July 14, 1909, *et seq.* Ills. 4500 w. Stahl u Eisen—July 27, 1910. No. 16582 D.

New Brunswick.

Bathurst District, New Brunswick. G. A. Young. Abstract from the summary report of the Geological Survey, describing this district. Map. 4500 w. Can Min Jour—Aug. 15, 1910. No. 16451.

Newfoundland.

See same title, under COPPER.

New York.

The Eastern Pig Iron Association at Port Henry. Report of a visit to Witherbee, Sherman & Co.'s properties in the eastern Adirondack district, describing important new mining and concentrating operations. 5000 w. Ir Age—Aug. 4, 1910. No. 16157.

Open-Hearth Furnaces.

Open Hearth Furnace Construction. O. Friedrich. Abstract translation of paper read at the Dusseldorf Cong. Illustrates and describes improvements in recent years as developed by German engineers. 1500 w. Ir Age—Aug. 25, 1910. No. 16624.

Ore Resources.

The Iron Ore Resources of the World. Reviews a recent work published in Sweden which shows the available supply to be sufficient for 200 years at the present rate of consumption. 2000 w. Ir Age—Aug. 11, 1910. No. 16268.

Rolling Mills.

The Rolling of Iron and Steel. Oscar C. Morgan. Abstract of paper read before the Nottingham Guild of Mech. & Elec. Engrs. Considers the nature of the action of rolls, and the effect on the piece under operation, effect on the rolls, effect of temperature, and matters related. 5500 w. Ir & Coal Trds Rev—July 29, 1910. No. 16258 A.

Improvements in Rolling Mill Construction. H. Ortmann. Abstract of paper read before the Int. Cong. at Dusseldorf. Review of changes introduced during the last ten years. 2000 w. Ir & Coal Trds Rev—Aug. 12, 1910. No. 16607 A.

Improvements in Electric Driving and Control for Rolling Mills. H. Ortmann. From a paper read before the Int. Cong. at Dusseldorf. Illustrates and describes recent arrangements for electric rolling-mill drives. 1500 w. Ir & Coal Trds Rev—Aug. 5, 1910. No. 16366 A.

Features of Construction and Operation of the Three-High Universal Plate Mill. B. H. Reddy. Discusses the advantages of the universal mill and some of the problems to be considered in the design of the modern mill. Ills. 3500 w. Ir Trd Rev—Aug. 18, 1910. No. 16437.

The Gary Car Axle Mill. Illustrated description of the Indiana Steel Company's axle plant. 2500 w. Ir Age—Aug. 18, 1910. No. 16435.

The Rolling of Sheets and Tin Plate (Das Walzen von Fein- und Weissblechen). W. Krämer. Discusses English and German competition and describes a typical plate mill. Ills. 5000 w. Stahl u Eisen—July 6, 1910. No. 16575 D.

An Investigation of the Power Requirements of Rolling Mills (Essais sur la Détermination de la Dépense d'Energie des Laminoirs). J. Puppe. An abstract translation of a paper before the Verein

We supply copies of these articles. See page 158.

Deutscher Eisenhüttenleute. Ills. 5000 w. Rev de Métal—July, 1910. No. 16518 E + F.

Steel Works.

The Cambria Steel Works. An illustrated article describing the main features of these works, its products, organization, and other matters of interest. 5000 w. Ry Age Gaz—Aug. 19, 1910. No. 16462.

The Rasselstein Steel Works (Eisenwerk Rasselstein). Describes the recent developments in the oldest steel works in Germany. Ills. 3000 w. Stahl u Eisen—July 6, 1910. No. 16574 D.

Tin Plate.

The Production of Tin Plate (Ueber Weissblecherzeugung). B. v. Clement. Describes, and compares with German, English practice and product. Ills. 9500 w. Stahl u Eisen—July 6, 1910. No. 16576 D.

See also Rolling Mills, under IRON AND STEEL.

LEAD AND ZINC.

Arkansas.

Zinc and Lead in Arkansas. Lucius L. Wittich. Reports the change from tunnel to shaft mining in developing a new region, in order to reach deeper deposits. 2000 w. Mines & Min—Aug., 1910. No. 16092 C.

Australia.

Geology of the Broken Hill Lode. Information from the Interim Report of the Geological Committee. 5000 w. Aust Min Stand—June 22, 1910. No. 16121 B.

Lead Desilverizing.

Parke's Process for Desilverizing Lead. John K. Archer. Describes the Parke process in operation at the Port Pirie (S. Aust.) works of the Broken Hill Proprietary Co. 1500 w. Aust Min Stand—July 27, 1910. No. 16746 B.

Zinc Smelting.

Fume Filtration for Production of Pure Spelter. John S. G. Primrose. Describes the process as carried out at Irvine, Scotland. Ills. 3000 w. Eng & Min Jour—Aug. 27, 1910. No. 16676.

Smelting Briquetted Zinc Ore. Theodore J. Hoover. Reports a zinc-smelting test made on mixed concentrates by the briquetting process. 1500 w. Eng & Min Jour—Aug. 13, 1910. No. 16334.

MINOR MINERALS.

Aluminium.

The Aluminium Works at Kinlochleven. Abstract of a paper by A. Alban H. Scott, read before the Concrete Inst., describing the works of the British Aluminium Co. 1800 w. Engr, Lond—July 22, 1910. No. 16152 A.

Asbestos.

On the Distribution of Asbestos Deposits in the Eastern Townships of Quebec. John A. Dresser. Shows some of the geological relations of the serpentine belt and how they determine the distribution of the mineral deposits. 4500 w. Can Min Jour—Aug. 1, 1910. No. 16079.

Clays.

The Clay and Shale Deposits of Nova Scotia and Portions of New Brunswick and Prince Edward Island. Heinrich Ries. A study to ascertain what deposits are adapted to the manufacture of clay products. 1200 w. Can Min Jour—Aug. 1, 1910. Serial. 1st part. No. 16080.

Diamonds.

Diamond Mines of Arkansas John L. Cowan. Information concerning their discovery and probable value. Ills. 2000 w. Min & Sci Pr—Aug. 6, 1910. No. 16303.

Mica.

Mica in the Black Hills of South Dakota. Jesse Simmons. A report of the different districts and present condition of the industry. 2500 w. Min Wld—Aug. 6, 1910. No. 16224.

Molybdenite.

The Occurrences of Molybdenite in Arizona. F. Schrader and J. M. Hill. Describes the deposits, their localities and development, and discusses their origin. Map. 3500 w. Min Wld—July 30, 1910. No. 16075.

Nickel.

See Smelting, under COPPER.

Oil.

Oil Shale Deposits, Blue Mountains, N. S. W. H. L. Jene. Describes shale in Australia similar to the Scotland deposits, and the system of working. 1500 w. Eng & Min Jour—Aug 27, 1910. No. 16673.

Some Notes on the History of Petroleum. Gordon Surr. Interesting information concerning the earliest known uses. 1800 w. Min Wld—Aug. 13, 1910. No. 16371.

Conditions Favorable for Petroleum Prospecting. Gordon Surr. Calls attention to geological and surface indications favorable for accumulation of petroleum. 1500 w. Min Wld—Aug. 6, 1910. No. 16225.

Geology of the Coalinga Oil Field. Illustrates and describes the distinguishing rocks and fossils of this California oil-field. 2000 w. Mines & Min—Aug, 1910. No. 16090 C.

Acquisition of Public Oil Lands. William Forstner. Discusses the law and regulations formerly affecting these lands, and the new law recently passed. 2000 w. Min & Sci Pr—Aug. 6, 1910. No. 16301.

Determination of the Source of a Naphtha or of Its Derivatives (Determination de la Provenance d'un Naphte ou de ses Dérivés). N. Chercheffsky. Gives data based on numerous analyses by which the country of origin of petroleum products may be determined. 2500 w. Bul Soc d' Encour—June, 1910. No. 16520 G.

Platinum.

Original Occurrences of Platinum in the Urals. E. de Hautpick. Reports investi-

gations carried out to discover new original sources of platinum. 1500 w. Min Jour—July 30, 1910. Serial. 1st part. No. 16243 A

Slate.

Peach Bottom Slate Deposits, Pennsylvania. Edw. G. W. Ferguson. Describes these deposits. Ills. 1200 w. Min Wld—July 30, 1910. No. 16074

Tin.

Mount Bischoff Tin Mine, Tasmania. J. D. Millen. Map and illustrated description of this property and its development. 1800 w. Min Jour—Aug 6, 1910 Serial. 1st part. No. 16343 A

Titanium.

New Rutile Deposits Near Richmond, Va. Frank H. Hess. Describes deposits of this titaniferous mineral. Ills. 1500 w. Min Wld—Aug. 20, 1910. No. 16455.

MINING.

Accidents.

Mining Accidents. T. Good. A review of present conditions in Great Britain. 2200 w. Cassier's Mag—Aug., 1910. No. 16293 B.

See also same title, under COAL AND COKE.

Accounting.

Cost Distribution at the Montezuma Mines. S. F. Shaw. Describes the system of accounting adopted at these Costa Rica Mines. 1500 w. Min Wld—Sept. 3, 1910. No. 16926.

See also Mine Accounting, under COAL AND COKE.

Drills.

Pneumatic, Hydraulic, and Electric Drills (Perforatrices à Commande pneumatique, hydraulique, ou électrique). F. Hofer. A brief review of the leading types. Ills. 5000 w. Génie Civil—July 9, 1910. No. 16546 D.

Drill Sharpening.

Sharpening Miner's Tools. Matt W. Alderson. Suggestions and remarks. 1500 w. Min Wld—Aug. 6, 1910. No. 16227.

Explosives.

Explosives. F. H. Gunsolus. Brief review of advances made in the manufacture, handling, storage and use of explosives since 1886. 2500 w. Jour Fr Inst—Aug., 1910. No. 16379 D.

See also same title, under COAL AND COKE.

Finance.

Methods of Promoting or Financing a Mine. Francis C. Nicholas. Critical discussion of different plans and methods. 4000 w. Min Wld—Aug. 20, 1910. No. 16457.

Hoisting Engines.

Overwinding and Overspeed Controller for Winding Engines. Illustrated description of Wilde and Petrie's gear. 1000 w. Col Guard—Aug. 19, 1910. No. 16712 A.

The Control of Hoisting Engines, Rolling Mills, and Three-Phase Generating Stations (Die Lenkung von Fördermaschinen, Walzwerkantrieben und Drehstromzentralen). H. Hoffmann. Read at the Düsseldorf Congress. Advocates control by means of devices independent of the load. Ills. 4000 w. Glückauf—July 9, 1910. No. 16588 D.

Methods.

Top-Slicing Mining Methods at Cananea, Mexico. Courtenay De Kalb. Describes an adaptation of top-slicing in the Oversight mine. Ills. 800 w. Min & Sci Pr—Aug. 20, 1910. No. 16647.

Mine Locomotives.

Gasoline Mine Locomotives. Illustrated descriptions of gasoline locomotives successfully used in Germany for mine haulage. 2000 w. Mines & Min—Aug., 1910. No. 16095 C.

Plants.

Design of a Mine Plant. J. W. Whitehurst and W. P. Cary. Student's prize paper. An illustrated study. 2200 w. Min & Sci Pr—Aug. 13, 1910. Serial. 1st part. No. 16438.

Prospecting.

See Oil, under MINOR MINERALS.

Pumping.

Recent Developments in Pumping Equipment (Neuerungen auf dem Gebiete der Wasserhaltung). Herr Schultze. Read at the Düsseldorf Congress. Describes a number of German installations. Ills. 5500 w. Glückauf—July 16, 1910. No. 16590 D.

Quarrying.

The Kentish Ragstone Quarries. P. Walton Harrison. Illustrates and describes the methods of quarrying, the cost and uses of materials. 1800 w. Surveyor—Aug. 12, 1910. No. 16494 A.

The Scottish Granite Industry. William Diack. Illustrated description of granite quarrying and working in Aberdeenshire. 3000 w. Cassier's Mag—Aug., 1910. No. 16288 B.

Shaft Sinking.

Shaft Sinking and Power Production at the Hattorf Potash Mines (Das Schachtabteufen und die Krafterzeugungsanlagen der Kaliwerke Hattorf). E. Koch. Describes the deepening of the shaft and the surface plant. Ills. 3200 w. Glückauf—July 23, 1910. No. 16591 D.

Stowing.

Sand-Filling on the Witwatersrand. Edgar Pam. Describes methods used, stating advantages. General discussion. Ills. 3000 w. Jour Chem., Met., & Min Soc of S. Africa—June, 1910. No. 16484 E.

Timber Flume.

Water Flume Conveyors at Mount Lyell. E. Carus Driffield Abridged paper read at Aust. Inst. of Min. Engrs. Illustrated description of method of transporting fire-wood, explaining conditions. 4000 w. Queens Gov Min Jour—July 15, 1910. No. 16729 B.

We supply copies of these articles. See page 158.

ORE DRESSING AND CONCENTRATION.

Briquetting.

See also Blast-Furnace Practice, under IRON AND STEEL.

Copper.

Miami Concentrating Mill. R. L. Herrick. Illustrates and describes features of construction that tend to economy. 2500 w. Mines & Min—Aug., 1910. No. 16089 C.

Crushing.

Some of the Mathematical Laws of Crushing. A. W. Warwick. Reviews briefly investigations made and laws laid down, criticising some of the statements, and the work of the Mines Trials Committee of S. Africa. 4000 w. Min Wld—July 30, 1910. No. 16073.

See also Screen Analyses, under ORE DRESSING AND CONCENTRATION.

Recovery.

Calculations of Percentage of Recovery. Theodore J. Hoover. Considers methods of calculation in concentration operations. 1500 w. Mining Mag—Aug., 1910. No. 16637 B.

Screen Analyses.

Grading Analyses and Their Application. H. Stadler. Shows how the varying proportions of certain standard sizes of particles may be valued in units of energy, which will allow of an exact expresson of the efficiency of the crushing operation for comparison. 5000 w. Jour Chem, Met, & Min Soc of S Africa—May, 1910. No. 16118 E.

Slimes Treatment.

The Chemical Control of Slimes. Harrison Everett Ashley. Aims to show that certain chemical considerations may greatly hinder or assist the successful operation of mechanical processes used. Ills. 3000 w. Bul Am Inst of Min Engrs—Aug., 1910. No. 16408 F.

Concentration of Slime. Edwin A. Sperry. Discusses the subject under the heads of crushing and grinding, sizing, classification, dewatering, and final treatment. 3500 w. Min & Sci Pr—Aug. 6, 1910. Serial. 1st part. No. 16302.

Slime Treatment at the Santa Natalia Mill. Cooper Shapeley. Plan and detailed description of the equipment and process. 1200 w. Eng & Min Jour—Aug. 20, 1910. No. 16463.

Tailings Disposal.

The Calumet & Hecla Sand Wheels. C. L. C. Fichtel. Illustrated description of a tailings wheel and its operation. 800 w. Eng & Min Jour—July 30, 1910. No. 16067.

Water Supply.

Tailing Dams and Conservation of Mill Water. W. H. Storms. Describes methods used when water is scarce to recover mill water for repeated use. Ills. 2200 w. Eng & Min Jour—Aug. 6, 1910. No. 16210.

MISCELLANY.

Australia.

Queensland Mines Inspection C. F. V. Jackson. Extracts from the chief inspector's report for 1909 in regard to labor, wages, accidents, ventilation, etc. Ills. 8500 w. Queens Gov Min Jour—June 15, 1910. No. 16123 B.

British Columbia.

Mineral Production of British Columbia in 1909. Information from the Annual Report of the Minister of Mines. 2500 w. Can Min Jour—Aug. 1, 1910. No. 16078.

Dusseldorf Congress.

The International Congress, Düsseldorf, 1910 (Der Internationale Kongress Düsseldorf 1910). A detailed report of the proceedings. Serial. 1st part. 7200 w. Glückauf—July 23, 1910. No. 16592 D.

Geology.

Nature of the Earth's Interior. Prof. E. H. L. Schwarz. Discusses its relation to the question of deep mining. 3500 w. Sci Am Sup—Aug. 13, 1910. No. 16285.

Government Bounties.

State Assistance to Mining. C. F. V. Jackson. Abstract of a paper read before the Mount Morgan meeting of the Aust. Inst. of Min. Engrs. Describes briefly the practice, methods, expenditure and some results. 3500 w. Aust Min Stand—July 6, 1910. No. 16416 B.

Nicaragua.

Mining in Nicaragua. T. Lane Carter. Explanation of conditions, reviewing briefly the history of mining in this region. Ills. 3500 w. Mining Mag—Aug., 1910. No. 16638 B.

Ore Deposits.

A Replacement of Rhyolite Porphyry by Stephanite and Chalcopyrite at Leadville. Clarence N. Fenner. Describes an interesting form of metasomatic replacement. Ills. 1000 w. Sch of Mines Qr—April, 1910. No. 16478 D.

The Importance of the Porphyry Coppers. Charles R. Keyes. Discusses ore deposits of the arid regions and the effect of physical conditions and related matters. 1500 w. Min Wld—Aug. 6, 1910. No. 16226.

Refractory Materials.

Analyses of Rhine Clays, with Special Reference to Their Content of Fluxing Materials (Ueber Analysen rheinischer Tone mit besonderer Berücksichtigung der Flussmittel). Dr. Fuchs. A consideration of the relation between fluxing materials and alumina in the West-Germany fireclays. 2000 w. Stahl u Eisen—July 20, 1910. No. 16581 D.

Washington.

Operations in the Covada District, Washington. Brief report of mines yielding gold, silver, copper, lead, zinc and antimony. 1500 w. Min Wld—Aug. 27, 1910. No. 16685.

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RAILWAY ENGINEERING.

CONDUCTING TRANSPORTATION.

Signalling.

An Improvement to the Aubine Signal Apparatus (Sur un Dispositif additionnel permettant l'Emploi de l'Appareil Aubine pour la Fermeture automatique des Signaux de Chemins de Fer carrés et Munis de Pétardo). Léon Lejeune. Describes an improved arrangement devised by the author. Ills. 1500 w. L'Elecn—July 9, 1910. No. 16540 D.

Train Despatching.

The Duties of the Chief Despatcher. A discussion of the duties and the difficulties. 2500 w. Ry Age Gaz—Aug. 12, 1910. No. 16321.

MOTIVE POWER AND EQUIPMENT.

Air Brakes.

Brakes Creeping On. Explanatory comments. 2000 w. Ry & Loc Engng—Aug., 1910. No. 16101 C.

The Passenger Control Equipment. Illustrated description of the Westinghouse general arrangement. 1500 w. Ry & Loc Engng—Aug., 1910. No. 16100 C.

Couplings.

International Competition on Automatic Couplings for Railway Cars (Concorso Internazionale per l'Agganciamento automatico dei Vagoni ferroviari). A report of practical tests of the prize-winning devices exhibited at Milan, 1906. Serial. 1st part. 3000 w. Monit Tech—July 10, 1910. No. 16564 D.

Electrification.

Electric Power for Railroad Operation. Fred. Darlington. Mainly a discussion of the commercial aspects. Ills. 5000 w. Pro Richmond R R Club—March 14, 1910. No. 16389.

Electrification of Suburban Railways. F. W. Carter. Discusses the advantages of electrification of existing steam-operated lines for suburban service in England. 8000 w. Inst of Mech Engrs—July, 1910. No. 16249 N.

The Cost of Electrically-Propelled Suburban Trains. H. M. Hobart. A comparison of systems, showing that the continuous system has decided commercial advantages over the single-phase system for this service. 9000 w. Inst of Mech Engrs—July, 1910. No. 16247 N.

Locomotive Boiler Waters.

Water Softening Plants of the Florida East Coast Railway. A. C. Tomlinson. Illustrates and describes the locomotive water-softening plants, and reports concerning their operation. 2200 w. Eng News—Aug. 11, 1910. No. 16317.

Locomotive Construction.

The Selection of Steel for Locomotive Construction. W. L. Turner. Shows the need of thoroughly testing the qualities imparted by an alloy to steel. 1500 w. Ir & Coal Trds Rev—Aug. 19, 1910. No. 16723 A.

Report No. 5 for All Countries Except America on the Question of the Use of Steel. Ernest Szlabey. The use of steel in the construction of locomotives and rolling stock. Ills. 5000 w. Bul Int Ry Cong—June, 1910. No. 16413 G.

Locomotive Feed Waters.

Corrosive Properties of Boiler Feed Waters. Report by J. G. Scrugham, for the Oregon Short Line R. R. and the So. Pacific Lines east of Sparks, Nev. Covers examination and tests of 110 varieties, and discusses the causes of corrosion and incrustation, and the methods of inhibiting. 3000 w. Ry & Engng Rev—Aug. 27, 1910. No. 16687.

Locomotive Fireboxes.

Improved Firebox with Hollow Arch and Combustion Chamber. F. F. Gaines. Explains mechanical defects in the present form of firebox with combustion chamber and describes improvements. Ills. 1600 w. Ry Age Gaz—Aug. 5, 1910. No. 16192.

Locomotive Headlights.

The Peters Electric Headlight System. Illustrated description of a new headlight for steam locomotives employing a turbo-generator. 1200 w. Ir Age—Aug. 18, 1910. No. 16436.

Locomotive Power.

Characteristic Energy Diagrams for Steam Locomotives. W. E. Dalby. Gives curves from recent test reports and shows how useful they are in comparing engine performances and power. Plate. 5000 w. Engng—Aug. 19, 1910. Serial. 1st part, No. 16713 A.

Locomotive Repairs.

Cylinder Replacement Practice at the Juniata Shops. Ralph E. Flanders. Illustrated description of a method adopted for use in repair shops anywhere. 1000 w. Mach, N Y (Ry Ed)—Aug., 1910. No. 16267 C.

Locomotives.

Mallet Articulated Locomotives, 2-6-8-0 Type. Illustration, with explanation of the principal changes made in the design of new engines for the Great Northern Ry. 1500 w. Am Engr & R R Jour—Aug., 1910. No. 16196 C.

Mikado Locomotive for the Atlanta, Birmingham & Atlantic. Illustration, description and dimensions. 700 w. Ry Age Gaz—Aug. 12, 1910. No. 16322.

Some Details of the Articulated Compound Locomotive Built at the Shops of

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the Canadian Pacific Railway. Illustrates and describes a number of interesting features. 1500 w. Am Engr & R R Jour—Aug., 1910. No. 16195 C.

Locomotive for the Soudan Government Railways. Plate and illustrated description of a new type of novel design. 300 w. Engr, Lond—July 22, 1910. No. 16150 A.

Locomotives for the Shanghai-Nanking Railway. Illustrated description of four single driven express passenger engines, built in record time. 600 w. Engr, Lond—July 29, 1910. No. 16254 A.

Compound Freight Locomotive with four Coupled Axles and Pilot Truck of the Paris-Lyons-Mediterranean Railway (Locomotive à Marchandises compound à quatre Essieux Couplés et à Bogie avant de la Compagnie Paris-Lyon-Méditerranée). Illustrated description. 2500 w. Génie Civil—July 16, 1910. No. 16549 D.

A French Express Locomotive at the Brussels Exposition. Brief illustrated description of an interesting locomotive to which has been adapted a marine type of water-tube firebox. 1000 w. Ry & Engng Rev—Aug. 27, 1910. No. 16686.

High-Power Locomotives at the Brussels Exhibition. Charles R. King. Illustrates and describes exhibits showing latest European designs. 1200 w. Mach, N Y (Ry Ed)—Aug., 1910. No. 16266 C.

The Locomotives at the Brussels Exhibition (Die Lokomotiven auf der Weltausstellung in Brüssel 1910). Herr Metzeltin. A preliminary report. Ills. 5500 w. Zeitschr d Ver Deutscher Ing—July 9, 1910. No. 16782 D.

Locomotive Speed Gauge.

A Locomotive Speed-Gauge. Alfred Gradenwitz. Illustrated description of a novel electrical speed-gauge based on the voltmeter principle. 1200 w. Sci Am Sup—Aug. 6, 1910. No. 16169.

Locomotive Speeds.

Report No. 2 for All Countries Except America on the Question of Steam Locomotives for Very High Speeds. Mr. Courtin. Gives results of the inquiry concerning locomotives for regulation speeds exceeding 60 miles per hour. Ills. 13000 w. Bul Int Ry Cong—June, 1910. No. 16412 G.

Locomotive Superheaters.

The Application of Superheated Steam to Locomotives (L'Application de la Vapeur surchauffée à l'Exploitation des Locomotives). A detailed description of the Schmidt apparatus and a report of results. Ills. 9500 w. All Indus—July, 1910. No. 16532 D.

Locomotive Valve Gears.

Walschaert Valve Gear. Benjamin Frey. A paper being used as an introduction to a course on the Walschaert valve gear for machinist apprentices on the New York Central lines. 3000 w. Ry Age Gaz—Sept. 2, 1910. No. 16863.

Passenger Cars.

The Paris-Lyons-Mediterranean Railway Carriages at the Brussels Exhibition. Illustrates and describes first-class and composite carriages. 1000 w. Engng—Aug. 5, 1910. No. 16355 A.

Safety Appliances.

Proposed United States Safety-Appliance Standards for the Protection of Employees and Travelers upon Railroads. Gives safety appliance acts passed, and the proposed U. S. safety appliance standards. Ills. 25000 w. Interstate Commerce Commission—1910. No. 16377 N.

Shops.

The Central of Georgia Railway Erecting and Machine Shop. Illustrates and describes new shops at Macon, Georgia. 2500 w. Eng Rec—July 30, 1910. No. 16064.

History of the Schenectady Locomotive Works. Extracts from an article by Hawley B. Van Vechten in "Loco" for May, 1910. A review. 3500 w. Ry & Engng Rev—Aug. 6, 1910. No. 16228.

Sleeping Cars.

Car Construction of the International Sleeping-Car Company from 1872 to 1909 (Note sur le Matériel de la Compagnie internationale des Wagon-lits et des Grands Express Européens construit de 1872 à 1909). A review of the development of sleeping cars in Europe. Ills. 16000 w. Rev Gen d Chemins de Fer—July, 1910. No. 16521 G.

Wrecking Equipment.

See Cranes, under MECHANICAL ENGINEERING, TRANSPORTING AND CONVEYING.

NEW PROJECTS.

Italy.

The Splugen Pass Railway (Il Valico Ferroviario dello Spluga). Ugo Ancona. A detailed consideration of the project, from the Italian point of view. Ills. Serial. 1st part. 5000 w. Ing Ferro—July 16, 1910. No. 16571 D.

PERMANENT WAY AND BUILDINGS.

Construction.

Heavy Railway Work Along the Des Chutes River, in Oregon. Describes the topography of the region and the parallel lines of the Des Chutes Ry., and the Oregon Trunk Ry. now being built. Map & Ills. 3000 w. Eng News—Aug. 11, 1910. No. 16309.

Rack Railways.

The Rochette-Asiago Rack Railway (Le Ferrovia a Dentiera Rocchette-Asiago). Giovanni Letter. Detailed description of the line and rolling stock. Ills. 5500 w. Ing Ferro—July 1, 1910. No. 16570 D.

Rail Tests.

Elongation and Ductility Tests of Rail

Sections. P. H. Dudley. Read at Atlantic City meeting of Am. Soc. for Test. Mat. Discusses the results obtained with a new standard drop-testing machine. 3000 w. Ir Trd Rev—Sept. 1, 1910. No. 16858.

Roundhouses.

English Running-Shed Practice. Cecil W. Paget. An illustrated description of the equipment of a running shed, and some features of its management. 5000 w. Inst of Mech Engrs—July, 1910. No. 16246 N.

Terminals.

The Reconstruction of the Passenger Terminals at Washington, D. C. W. F. Strouse. Illustrated detailed description of the design and construction of the new terminal station at Washington. Pro Am Soc of Civ Engrs—Aug., 1910. No. 16641 F.

The Pennsylvania Railroad Improvements About New York. A finely illustrated article describing the tunnel systems and their connections, the New York terminal station building, and the engineering features in the terminal area. 6800 w. Archts & Bldrs' Mag—July, 1910. No. 16044 C.

East Boston Deep-Water Terminal of the Boston & Albany Railroad. Luis G. Morphy. Brief account of the fire that destroyed this terminal in 1908, and illustrated description of the reconstruction and improvements. 6000 w. Jour Assn of Engng Socs—July, 1910. No. 16829 C.

Ties.

See also Timber Preservation, under CIVIL ENGINEERING, MATERIALS OF CONSTRUCTION.

Track Construction.

Record of Gravel Ballasting Using Hopper Bottom Coal Cars on a 75-Mile Haul. D. A. Wallace. A record of efficient work under difficult conditions. 1200 w. Engng-Con—Aug. 3, 1910. No. 16166

New Methods of Studying Track-Laying Problems (Méthodes nouvelles pour l'Etude des Tracés de Voies de Chemins de Fer). P. Le Fort. Describes in detail methods of solving problems of elevation, curvature, super-elevation, etc. Ills. 13200 w. Mem Soc Ing Civ de France—May, 1910. No. 16506 G.

MISCELLANY.

Austria.

Lines of Local Interest and Railway Projects in the Tyrol (Ueber die Lokalbahnverhältnisse und Bahnprojekte in Tirol). J. Riehl. A review of railway development in this part of Austria. 7000 w. Mitt d Ver f d Förd d Lokal- u Strassenbahnwesens—July, 1910. No. 16573 F.

Brazil.

The Rio Grande del Sud Railway (Les Chemins de Fer du Rio Grande du Sud). Lionel Wiener. A description of this Brazilian railway. Ills. 14000 w. Rev Gen d Chemins de Fer—July, 1910. No. 16522 G.

China.

The Imperial Peking-Kalgan Railway and Its Extension. J. L. Dobbins. An illustrated description of an important railway built entirely by the Chinese. 2800 w. Eng News—Aug. 25, 1910. No. 16626.

Germany.

Modern Secondary Railways in Bavaria (Modern betriebene Nebenbahnen in Bayern). Hermann R. v. Littrow. A comparison, technical and economic, with similar railways in Austria. 3000 w. Zeitschr d Oest Ing u Arch Ver—July 1, 1910. No. 16755 D.

Government Control.

Requirements for British Railways. Extracts from an official circular giving the requirements of the British Board of Trade in regard to the opening of railways. 5000 w. Ry & Engng Rev—July 30, 1910. No. 16088.

Ireland.

The Irish Railway Commission. Detailed account of the proceedings and opinions of the Commission appointed to inquire into the system of working on the Irish railways. 2500 w. Engr, Lond—Aug. 5, 1910. Serial. 1st part. No. 16359 A.

Russia.

Transportation and Traffic in Russia. Logan M'Pherson. A preliminary report to the United Waterways Commission. Reviews the development giving facts and statistics obtained officially. 2200 w. Ry Age Gaz—Aug. 5, 1910. No. 16191.

Sierra Leone.

The Sierra Leone Government Railway. Edgar Allen Forbes. Illustrated description of this African system and its operation. 3500 w. Ry Age Gaz—Aug. 26, 1910. No. 16655.

Statistics.

Report No. 4 for North America on the Question of Statistics. A. J. County. Concerning the principles of statistics of railways in operation. 19000 w. Bul Int Ry Cong—June, 1910. No. 16414 G.

Switzerland.

The Construction of Some Mountain Railways in the Canton of Vaud (Notice sur la Construction de quelques Routes de Montagne dans le Canton de Vaud). H. Develey. The first part begins a description of the Aigle-Château-d'Oex line. Ills. Serial. 1st part. 2000 w. Bul Tech d l Suisse Rom—July 25, 1910. No. 16536 D.

Progress on the Bernese Alpine Railway (Etat actuel des Travaux du Chemin de Fer des Alpes Bernoises). Ch. Dantin. Describes the present state of the construction of the line which includes the Lötschberg tunnel. Ills. 5000 w. Génie Civil—July 2, 1910. No. 16544 D.

We supply copies of these articles. See page 158.

STREET AND ELECTRIC RAILWAYS.

Berlin.

Berlin's Traffic Problem and the Greater Berlin Competition (Berliner Verkehrsfragen und der Wettbewerb Gross-Berlin). Herr Schimpff. Discusses the need for increased facilities, and a number of designs for extensions submitted in competition. Ills. Serial. 1st part. 4500 w. Elek Kraft u Bahnen—July 14, 1910. No. 16769 D.

Brakes.

Tramway Motor-Car Brakes (Notice sur les Freins des Voitures motrices de Tramways). Marcel Leboucq. Describes particularly the Chaumont system. Ills. 3300 w. Soc Belge d'Elecns—June, 1910. No. 16501 E.

Car Tests.

Car Tests in Philadelphia with Anti-Friction Bearings. Arthur B. Stitzer. Reports a series of tests with anti-friction armature and journal bearings made under regular running conditions for nearly a year. Ills. 1800 w. Elec Ry Jour—Aug. 27, 1910. No. 16649.

Depreciation.

Tramway Depreciation. A. J. J. Pfeiffer. A discussion of the subject from the viewpoint of conditions in Great Britain. 3500 w. Tram & Ry Wld—Aug. 4, 1910. No. 16486 B.

Direct Current.

High-Tension Direct-Current for Electric Railway Traction. Discusses the advantages of this system. 1500 w. Elec Rev, Lond—Aug. 19, 1910. No. 16704 A.

Electric Traction.

Report No. 3 for Austria and Hungary on the Question of Electric Traction. Arthur Hruschka. Discussion of electric traction on large railroads in these countries, the continuous current and alternating current, and comparative cost. Ills. 23800 w. Bul Int Ry Cong—June, 1910. No. 16411 G.

An Investigation of the Safety of Electric Locomotives on Curves (Untersuchungen über das betriebssichere Durchfahren der Kurven mit elektrischen Lokomotiven unter besonderer Berücksichtigung des Einflusses der drehenden Lokomotivmassen). Kurt Wiesinger. Reports an investigation to determine the effect of the moving parts of the locomotive on its safe operation. Ills. 3200 w. Zeitschr f d Gesamte Turbinenwesen—July 2, 1910. No. 16766 D.

Instruction Car.

Instruction Car of the Boston & Northern Street Railway. Illustrated description of the car and its equipment. 3000 w. Elec Ry Jour—Aug. 13, 1910. No. 16319.

Italy.

Electric Traction on the Giovi Railway (La Trazione elettrica sul Valico dei Giovi). Illustrated description of this new three-phase line in Italy. Serial. 1st part. 2500 w. Monit Tech—July 20, 1910. No. 16565 D.

Locomotives.

Electrification of Italian State Railway. Warren H. Miller. Illustrated description of the 3-phase freight locomotives for the Giovo line. 2000 w. Elec Wld—Aug. 11, 1910. No. 16307.

Storage-Battery Locomotive for the Zürich Abbatoir (Akkumulatorenlokomotive des Schlachthofes der Stadt Zürich). H. Studer. Illustrated description. 1500 w. Schweiz Bau—July 2, 1910. No. 16597 B.

Municipal Control.

The Chicago Plan of Street Railway Supervision and Control. Sidney Ossoski. A discussion of the method evolved in the settlement of the traction difficulties in Chicago, which has been in use over three years. 3500 w. Elec Ry Jour—Aug. 6, 1910. No. 16203.

Pittsburgh.

Report on Financial and Operating Records of the Pittsburgh Railways. Gives practically the full text of report submitted by Bion J. Arnold. Also maps, diagrams, and tables. 2500 w. Elec Ry Jour—Aug. 13, 1910. No. 16320.

Pittsburg's Transit Problems: Reports by Bion J. Arnold. A review of reports on the troubles and proposed re-routing of cars and construction of a subway. Editorial note. 4000 w. Eng News—Aug. 4, 1910. No. 16175.

Signalling.

An Automatic Signal for Electric Railways. Carl P. Nachod. Describes a system in which the signals are caused to be displayed by the car or train having passed definite points where contact devices are located. Ills. 4000 w. Pro Engrs' Club of Phila—July, 1910. No. 16396 D.

Subways.

Cars, Schedules, Power Consumption, Running Tests and Signals in London Subways. An illustrated account of operating methods and devices used, reporting tests. 2500 w. Elec Ry Jour—Aug. 6, 1910. No. 16202.

Track Construction.

The Standardizing of Street Railway Track Construction in Paved Streets. B. E. Tilton. Abstract of paper read at meeting of the St. Ry. Assn. of the State of N. Y., with editorial discussion. 6000 w. Eng News—Aug. 4, 1910.. No. 16176.

We supply copies of these articles. See page 158.

EXPLANATORY NOTE—THE ENGINEERING INDEX

We hold ourselves ready to supply—usually by return of post—the full text of every article indexed in the preceding pages, *in the original language*, together with all accompanying illustrations; and our charge in each case is regulated by the cost of a single copy of the journal in which the article is published. The price of each article is indicated by the letter following the number. When no letter appears, the price of the article is 20 cts. The letter A, B, or C denotes a price of 40 cts.; D, of 60 cts.; E, of 80 cts.; F, of $1.00; G, of $1.20; H, of $1.60. When the letter N is used it indicates that copies are not readily obtainable and that particulars as to price will be supplied on application. Certain journals, however, make large extra charges for back numbers. In such cases we may have to increase proportionately the normal charge given in the Index. In ordering, care should be taken to *give the number* of the article desired, not the title alone.

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CARD INDEX.—These pages are issued separately from the Magazine, printed on one side of the paper only, and in this form they meet the exact requirements of those who desire to clip the items for card-index purposes. Thus printed they are supplied to regular subscribers of THE ENGINEERING MAGAZINE at 10 cents per month, or $1.00 a year; to non-subscribers, 25 cts. per month, or $3.00 a year.

THE PUBLICATIONS REGULARLY REVIEWED AND INDEXED

The titles and addresses of the journals regularly reviewed are given here in full, but only abbreviated titles are used in the index. In the list below, *w* indicates a weekly publication, *b-w*, a bi-weekly, *s-w*, a semi-weekly, *m*, a monthly, *b-m*, a bi-monthly, *t-m*, a tri-monthly, *qr*, a quarterly, *s-q*, semi-quarterly, etc. Other abbreviations used in the index are: Ill—Illustrated; W—Words; Anon—Anonymous.

Alliance Industrielle. *m.* Brussels.
American Architect. *w.* New York.
Am. Engineer and R. R. Journal. *m.* New York.
American Jl. of Science. *m.* New Haven, U. S. A.
American Machinist. *w.* New York.
Anales de la Soc. Cien. Argentina. *m.* Buenos Aires.
Annales des Ponts et Chaussées. *m.* Paris.
Ann. d Soc. Ing. d Arch Ital. *s-m.* Rome.
Architect. *w.* London.
Architectural Record. *m.* New York.
Architectural Review. *s-q.* Boston.
Architect's and Builder's Magazine. *m.* New York.
Australian Mining Standard. *w.* Melbourne.
Autocar. *w.* Coventry, England.
Automobile. *w.* New York.
Automotor Journal. *w.* London.
Beton und Eisen. *qr.* Vienna.
Boiler Maker. *m.* New York.
Brass World. *m.* Bridgeport, Conn.
Brickbuilder. *m.* Boston.
Builder. *w.* London.
Bull. Bur. of Standards. *qr.* Washington.
Bulletin de la Société d'Encouragement. *m.* Paris.
Bulletin of Dept. of Labor. *b-m.* Washington.
Bull. of Can. Min. Inst. *qr.* Montreal.
Bull. Soc. Int. d'Electriciens. *m.* Paris.
Bulletin of the Univ. of Wis., Madison, U. S. A.
Bull. Int. Railway Congress. *m.* Brussels.
Bull. Scien. de l'Assn. des Elèves des Ecoles Spéc. *m.* Liége.
Bull. Tech. de la Suisse Romande. *s-m.* Lausanne.
California Jour. of Tech. *m.* Berkeley, Cal.
Canadian Architect. *m.* Toronto.
Canadian Electrical News. *m.* Toronto.
Canadian Engineer. *w.* Toronto and Montreal.
Canadian Mining Journal. *b-w.* Toronto.
Cassier's Magazine. *m.* New York and London.
Castings. *m.* Cleveland, O.
Cement. *m.* New York.
Cement Age. *m.* New York.
Central Station. *m.* New York.
Chem. Met. Soc. of S. Africa. *m.* Johannesburg.
Colliery Guardian. *w.* London.
Commercial Vehicle. *m.* New York.

Compressed Air. *m.* New York.
Comptes Rendus de l' Acad. des Sciences. *w.* Paris.
Cornell Civil Engineer. *m.* Ithaca.
Deutsche Bauzeitung. *b-w.* Berlin.
Die Turbine. *s-m.* Berlin.
Domestic Engineering. *w.* Chicago.
Economic Geology. *m.* New Haven, Conn.
Electrical Age. *m.* New York.
Electrical Engineer. *m.* London.
Electrical Engineering. *w.* London.
Electrical Review. *w.* London.
Electrical Review. *w.* New York.
Electric Journal. *m.* Pittsburg, Pa.
Electric Railway Journal. *w.* New York.
Electrical World. *w.* New York.
Electrician. *w.* London.
Electricien. *w.* Paris.
Elektrische Kraftbetriebe u Bahnen. *w.* Munich.
Elektrochemische Zeitschrift. *m.* Berlin.
Elektrotechnik u Maschinenbau. *w.* Vienna.
Elektrotechnische Rundschau. *w.* Potsdam.
Elettricità. *w.* Milan.
Engineer. *w.* London.
Engineering. *w.* London.
Engineering-Contracting. *w.* New York.
Engineering Magazine. *m.* New York and London.
Engineering and Mining Journal. *w.* New York.
Engineering News. *w.* New York.
Engineering Record. *w.* New York.
Eng. Soc. of Western Penna. *m.* Pittsburg, U. S. A.
Foundry. *m.* Cleveland, U. S. A.
Génie Civil. *w.* Paris.
Giesserei-Zeitung. *s-m.* Berlin.
Glasers Ann. f Gewerbe & Bauwesen. *s-m.* Berlin.
Heating and Ventilating Mag. *m.* New York.
Horseless Age. *w.* New York.
Ice and Cold Storage. *m.* London.
Ice and Refrigeration. *m.* New York.
Il Cemento. *s-m.* Milan.
Industrial World. *w.* Pittsburg.
Ingegneria Ferroviaria. *s-m.* Rome.
Ingenieur. *w.* Hague.
Insurance Engineering. *m.* New York.
Int. Marine Engineering. *m.* New York.
Iron Age. *w.* New York.
Iron and Coal Trades Review. *w.* London.
Iron Trade Review. *w.* Cleveland, U. S. A.
Jour. of Accountancy. *m.* N. Y.
Journal Asso. Eng. Societies. *m.* Philadelphia.
Journal Franklin Institute. *m.* Philadelphia.
Jour. N. E. Water Works Assn. *qr.* Boston.
Journal Royal Inst. of Brit. Arch. *s-q.* London.
Jour. Roy. United Service Inst. *m.* London.
Journal of Sanitary Institute. *qr.* London.
Jour. of South African Assn. of Engineers. *m.* Johannesburg, S. A.
Journal of the Society of Arts. *w.* London.
Jour. Transvaal Inst. of Mech. Engrs., Johannesburg, S. A.
Jour. of U. S. Artillery. *b-m.* Fort Monroe, U. S. A
Jour. W. of Scot. Iron & Steel Inst. *m.* Glasgow.
Journal Western Soc. of Eng. *b-m.* Chicago.
Jour. of Worcester Poly. Inst., Worcester, U. S. A.
Locomotive. *m.* Hartford, U. S. A.
Machinery. *m.* New York.
Manufacturer's Record. *w.* Baltimore.
Marine Review. *m.* Cleveland, U. S. A.
Mechanical Engineer. *w.* London.
Mechanical World. *w.* Manchester.
Mem. de la Soc. des Ing. Civils de France. *m.* Paris.
Metallurgical and Chem. Engng. *m.* New York.
Métallurgie. *w.* Paris.
Metal Worker. *w.* New York.
Mines and Minerals. *m.* Scranton, U. S. A.
Mining and Sci. Press. *w.* San Francisco.
Mining Journal. *w.* London.
Mining Magazine. *m.* London.
Mining World. *w.* Chicago.
Mittheilungen des Vereins für die Förderung des Local- und Strassenbahnwesens. *m.* Vienna.
Municipal Engineering. *m.* Indianapolis, U. S. A.
Municipal Journal and Engineer. *w.* New York.
Nautical Gazette. *w.* New York.
New Zealand Mines Record. *m.* Wellington.
Oest. Wochensch. f. d. Oeff. Baudienst. *w.* Vienna.
Oest. Zeitschr. Berg- & Hüttenwesen. *w.* Vienna.
Plumber and Decorator. *m.* London.
Power and The Engineer. *w.* New York.
Practical Engineer. *w.* London.
Pro. Am. Ins. Electrical Eng. *m.* New York.
Pro. Am. Ins. of Mining Eng. *m.* New York.
Pro. Am. Soc. Civil Engineers. *m.* New York.
Pro. Am. Soc. Mech. Engineers. *m.* New York.
Pro. Canadian Soc. Civ. Engrs. *m.* Montreal.
Proceedings Engineers' Club. *qr.* Philadelphia.
Pro. Engrs. Soc. of Western Pennsylvania. *m.* Pittsburg.
Pro. St. Louis R'way Club. *m.* St. Louis, U. S. A.
Pro. U. S. Naval Inst. *qr.* Annapolis, Md.
Progressive Age. *s-m.* New York.
Public Works. *qr.* London.
Quarry. *m.* London.
Queensland Gov. Mining Jour. *m.* Brisbane, Australia.
Railway Age Gazette. *m.* New York.
Railway and Engineering Review. *w.* Chicago.
Railway and Loc. Engng. *m.* New York.
Railway Master Mechanic. *m.* Chicago.
Revue d'Electrochimie et d'Electrométallurgie. *m.* Paris.
Revue de Mécanique. *m.* Paris.
Revue de Métallurgie. *m.* Paris.
Revue Gén. des Chemins de Fer. *m.* Paris.
Revue Gén. des Sciences. *w.* Paris.
Revue Industrielle. *w.* Paris.
Rivista Marittima. *m.* Rome.
Rudder. *m.* New York.
Schiffbau. *s-m.* Berlin.
School of Mines Quarterly. *q.* New York.
Schweizerische Bauzeitung. *w.* Zürich.
Scientific American. *w.* New York.
Scientific Am. Supplement. *w.* New York.
Sibley Jour. of Mech. Eng. *m.* Ithaca, N. Y.
Signal Engineer. *m.* Chicago.
Soc. Belge des Elect'ns. *m.* Brussels.
Stahl und Eisen. *w.* Düsseldorf.
Stevens Institute Indicator. *qr.* Hoboken, U. S. A.
Surveyor. *w.* London.
Technik und Wirtschaft. *m.* Berlin.
Technique Moderne. *m.* Paris.
Tramway & Railway World. *m.* London.
Trans. Inst. of Engrs. & Shipbuilders in Scotland, Glasgow.
Wood Craft. *m.* Cleveland, U. S. A.
Yale Scientific Monthly. *m.* New Haven.
Zeitschr. f. d. Gesamte Turbinenwesen. *w.* Munich.
Zeitschr. d. Mitteleurop. Motorwagen. Ver. *s-m.* Berlin.
Zeitschr. d. Oest. Ing. u. Arch. Ver. *w.* Vienna.
Zeitschr. d. Ver. Deutscher Ing. *w.* Berlin.
Zeitschr. f. Werkzeugmaschinen. *b-w.* Berlin.

CURRENT RECORD OF NEW BOOKS

NOTE—Our readers may order through us any book here mentioned, remitting the publisher's price as given in each notice. Checks, Drafts, and Post Office Orders, home and foreign, should be made payable to THE ENGINEERING MAGAZINE.

High-Speed Steel.

High-Speed Steel. By O.. M. Becker. Size, 9 by 6 in.; pp., 360. Ills. Price, $4. New York and London: McGraw-Hill Book Company.

A considerable amount of the material in this book is based on Mr. Becker's contributions to THE ENGINEERING MAGAZINE during the last few years, and a large number of the illustrations are taken from the same source. Section I deals with the development and nature of high-speed steels, outlining their early history and, more fully, the recent developments. To Section II, which describes the manufacture of the steels and tools, more space is devoted than to any other of the main subdivisions. The steel-making, forging, heat-treatment, and grinding processes are discussed in detail; particular attention is paid to the methods of ascertaining and regulating temperatures. Section III considers the tool at work, the range of utility of high-speed steel, the conditions of maximum effect, and the proper adjustment of speeds and feeds. The fundamental considerations in the design of new tools, the new machine requirements, and the process of remodeling an old equipment are discussed in Section IV, while Section V is devoted to a statement of the economic problems involved in the use of high-speed steels. Section VI comprises a number of appendices giving data of the composition of the new steels, the proper cutting speeds, and the cost of removing metal. The book throughout is clearly written and is a welcome addition to the literature of modern production engineering.

Works Management.

Factory Organization and Administration. By Hugo Diemer, M. E., Professor in Industrial Engineering, Pennsylvania State College. Size, 9 by 6 in.; pp., 317. Ills. Price $3.00. New York and London: McGraw-Hill Book Company.

The author's preface explains that the work has gradually acquired its present form as the outcome of lecture courses delivered to senior engineering students. The subject matter and the manner of presentation and the point of view, however, seem to belong to the province of the practitioner rather than that of the student. Prof. Diemer's experience has been unusually diversified and has brought him at different times into many and various relations with many of the elements of factory administration. Probably for this reason he seems to interweave many lines of study in his approach to and treatment of the many topics taken up, sometimes with result of producing a mosaic effect, full of interesting bits, but confused as to proportion and perspective. The arrangement of the matter is in a sense logical. It begins with the economic theory of factory location, follows with the planning of factory buildings, and the influence upon design and output, takes up next staff and departmental organization and executive control, and then considers the individual departments—the general office, orders, drafting, pattern, purchasing, stores, production, foundry, machine-shop and tool room, shipping and receiving, timekeeping, and cost. After these come sections on aids in taking inventory, inspection methods, employment of labor, wage systems, fixing piece rates, the principles underlying good management, and lastly a bibliography. This is theoretically the order in which the manufacturing plant comes into existence, but it is not the order in which the individual mind proceeds to grasp the problem. The economic theory of factory location and the study of economic plant design presuppose matters which lie at the far end of Prof. Diemer's arrangement. A satisfactory introduction to the science can not be found by approaching it through these departments, however elementary the outline in which they are drawn. The work throughout is marked by diversity of information, generally by definiteness of perception and statement, but not by a satisfying analysis nor by recognition of the philosophy, or even the leading philosophies, of works management. This is particularly apparent in the chapter on wage systems. It conspicuously lacks in adequate discussion of transportation, or of that extremely important element of cost accounting, the distribution of expense. The bibliography of works management, Chapter XXVI, is reproduced verbatim from an article published in THE ENGINEERING MAGAZINE in July, 1904, except that the present chapter adds five books to the list then given—a totally inadequate record so far as the literature of the past six years is concerned, omitting, indeed, some of the most important contributions to it that have yet been made.